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The SCIENCE COUNSELOR

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The Science Counselor

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Good News!

The next **Duquesne University Conference for Teachers of Science in Catholic Schools** will be held in Pittsburgh on Saturday, February 21, 1942. The Administrative Officers of the University have so announced. They cordially invite **YOU** to attend.

This news will be welcome to the many teachers of science in the Eastern United States who have received help and inspiration at these one-day meetings. Conducted during the past eight years under the patronage of the Most Reverend Hugh C. Boyle, Bishop of Pittsburgh, the Conferences have grown in interest and importance until they now attract several hundred science instructors from the New York, Washington, Chicago, Milwaukee, Detroit district.

A strong program is being prepared. Addresses at the General Session will be given by the Very Reverend James A. Reeves, President of Seton Hill College, Greensburg, Pa.; by Dr. Wojciech Swietoslawski, internationally famous physical chemist and former Minister of Education of the Republic of Poland; and by Reverend Thomas J. Quigley, Superintendent of Catholic Schools, Diocese of Pittsburgh.

Demonstrations in physics, using fluorescent light, will be given by Mr. C. K. Chrestensen of the Clairton Public High School, Clairton, Pa.; in Biology by Sister M. Aelred, O.S.F., of St. Wendelin High School, Pittsburgh; and in General Science by David W. Rial, Principal of the Brashear Public School, Pittsburgh. Brother Lawrence Eveslage, S.M., of the Cathedral Latin High School, Cleveland, will preside at the Round Table in Physics.

There will be no display of student project material this year.

The Sisters Alumnae of Duquesne University will again act as hostesses. When the time of arrival is known in advance, Sisters who come from a distance will be met at trains and conducted to the Convents to which they have been assigned. Requests for accom-
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SAINT ALBERT, THE SCHOLAR

SAINT ALBERTUS MAGNUS

TODAY WITH REVERENT THOUGHT IN SUPPLIANT PRAYER
WE KNEEL BEFORE A SACRED SHRINE. IT WEARS
ITS SIMPLE GRANDEUR WITH HISTORIC PRIDE.
ALBERTUS MAGNUS IS THE NAME IT BEARS.

A PEERLESS LEADER OF THE BY GONE YEARS
HAD FLUNG HIS "VERITAS." ITS RADIANCE SHED
A LIGHT, THAT BLAZED A PATH SUBLIME TO GOD.
THE YOUTHFUL ALBERT FOLLOWED WHERE IT LED.

AN AGE OF CHANGING STANDARDS CHALLENGED THOSE
WHO FOUGHT FOR RIGHT. WHEN TRUTH ITSELF SEEMED DOOMED,
'MID MIGHTY INTELLECTS THAT GRACED HIS AGE
THE TOWERING GENIUS OF AN ALBERT LOOMED.

IN REALMS OF NATURE UNEXPLORED HE SEARCHED
WITH MIND UNERRING AND WITH JUDGMENT CLEAR.
HIS BRILLIANT FINDINGS IRKED THE LESSER MINDS
AND FILLED THE DOUBTING HEARTS WITH JEALOUS FEAR.

WHEN MIGHTY HERESIES HAD SPENT THEIR FORCE
A EUCHARISTIC RENAISSANCE OF THOUGHT
HAD FIRED HIS SOUL. WITH BURNING ELOQUENCE
THE MYSTERY OF A HOST MADE GOD HE TAUGHT.

AN ARDENT COURTIER OF A SINLESS QUEEN
HE HELD A LOVE UNBOUNDED AND UNPRICED
FOR HER, WHOSE SINLESS PURITY HAD SHAPED
A MYSTIC SHRINE FOR THE INCARNATE CHRIST.

ALBERTUS MAGNUS, SCHOLAR UNEXCELLED,
THE WORLD WRITES HIGH AMONG HER HONORED NAMES
A CHAMPION OF THE TRUTH IN ALL ITS WAYS.
THE CHURCH A DOCTOR UNIVERSAL CLAIMS.

THE WINDING DANUBE GENTLY LAVES THE SHORE
WHERE LAUINGEN WITH TOWERS OLD AND QUAINT
STILL PROUDLY GUARDS THE BIRTHPLACE OF HER SON
A POET, PRIEST, A SCIENTIST AND SAINT.

An Appreciation by

Sister Mary Gertrude Quinn, O.P., M.A.
PHYSICAL SCIENCE DEPARTMENT
TRINITY HIGH SCHOOL
RIVER FOREST, ILLINOIS

Feast of Saint Albert
November 15, 1941

Emotional Blocks

That Prevent the Mastery of Chemistry

• By G. M. Schmeing
DEPARTMENT OF CHEMISTRY, LOYOLA UNIVERSITY, CHICAGO, ILL.

Have you ever sought the reasons why certain students do not like chemistry? Should you find the causes for poor work, do you know how to remedy them? You should. This article will help you.

It is a careful analysis of the "human interest" side of the work of science teachers. No instructor can read it attentively without benefit.

We believe this should prove to be one of the most helpful papers we have published. It was presented by Professor Schmeing at the April, 1941, meeting of the American Chemical Society.

•

We shall start the discussion of this educational problem with the assumption that the school is what it should be. The teacher is versed in his subject, trained in classroom and laboratory teaching practice, skilled in presentation, able in imparting knowledge, successful in developing students, and properly advertised by his institution. The student has a high I. Q. But the student is not succeeding, which means that, in the case of this particular student, the teacher is not succeeding either.

The question for discussion is: "What can the teacher do to remedy this situation?"

Before an answer is attempted, a second question should be answered: "Why does the outlined situation arise?" The search for an answer takes us back to a few generally accepted statements.

The student, no matter how fine his intellect, must have an urge, a drive, a correct emotional attitude. The good intellect has been compared to a fine engine which requires fuel, an emotional drive. A combination of three emotions is best suited to supply the fuel for the student's intellectual engine: a firm conviction that the study in hand is worth while; a feeling that he can learn it; and a wholehearted trust in, and surrender to, the ministrations of the teacher. Any emotion, or any idea that prevents the realization of one or more of these three emotions, constitutes an emotional block stopping the road to success.

In brief review, these blocks are seven: the feeling that the subject-matter is trivial in itself, relatively unimportant, valueless in the student's chosen career, unsuited to the temperament and special abilities of the student, inherently too difficult, unworthy of the intellectual and cultural cost, and not worth the priceless spiritual "sacrifice" entailed.

Any remedies that are proposed must avoid these five pitfalls: 1. the student must not be antagonized; 2. the student must not be moved by any external compulsion; 3. no attack must be made upon another part of the curriculum; 4. no "idol" must be broken; 5. nothing good must be sacrificed.

Genuine sincerity must mark all such remedial work. The teacher must not present for acceptance by the student anything which the teacher himself does not accept. Care must be exercised to be certain that objective truth permeates the teacher-pupil relationship. Often the student can be led to abandon a harmful attitude by having him unearth the origin of the attitude. This may be accomplished by encouraging him to express himself in an interview with the teacher. During such an interview it is helpful if the teacher takes the attitude of listener and learner, genuinely interested in hearing why the student holds the view he professes. Under these conditions the student makes an effort to organize his case for presentation and to support it with reasons. This exercise often uncovers the fallacy or the weakness of the foundation upon which the student rests his erroneous and harmful views.

It is also helpful if the teacher takes the attitude that the removal of the impediment to success is the student's problem; that is, the student, not the teacher, must solve this problem. True, to solve a problem one must have the necessary data, and the teacher may assist the student to find data, to evaluate the data found, and to interpret the findings. But the student must solve the problem.

Considerations that may assist the student to rid himself of specific cases of emotional block will now be listed. To assist the student over the idea that the subject-matter of chemistry is trivial, attention may be called to the large number of excellent minds devoted to the study of chemistry in the past and at present. A careful consideration of the history of chemistry and a marshalling of present progress should be tried. A glance at a current issue of *Chemical Abstracts* should at least initiate a cure. The student may need to be reminded that the impressive array found in *Chemical Abstracts* is a mere two weeks' accumulation. The results of the application of chemistry to current practical problems in the field of applicability should form a strong impression.

The treatment of the case based on the value of chemistry in comparison with other parts of the curriculum must be handled with tact to prevent an implied attack on other fields of study. The comparative value of chemistry will hardly be questioned by the chemistry major. The Arts student and the Pre-medic may need our help at this point. In institutions in which the Arts students are provided with their own course the problem is not so apt to arise.

The Arts student may feel that the course in philosophy supplies all his informational and training needs. This trouble arises from a mistaken notion that philosophy treats, not of ultimate causes, but of all phases of all things. A careful look at the philosophy text should remedy the situation. The study of philosophy, if pursued successfully, should lead the student to place all things, including chemistry, in their proper order. Perhaps it can be very gently hinted that the student is not properly devoting himself to the study of the philosophy he regards so highly unless he considers chemistry important. Here the teacher must be particularly careful not to antagonize the student.

The Premedic is apt to think that chemistry should be neglected for biology. A study of the recommendations of the medical schools and of their spokesmen should be assigned. The recorded opinion of biologists regarding the relationship of their specialty to chemistry is useful. The student should be induced to budget his time and to abide by the slogan: "During *chemistry time* nothing is as important as chemistry."

The difficulty of not destroying "idols" is encountered when the teacher tries to assist the student who holds the notion that chemistry is not of value in the pursuit of his career. The trouble is symptomatic of certain kinds of pre-something-or-other students; for example, the Premedic who knows that he will not need chemistry in his career because his highly regarded family doctor told him so, or because his father who is a successful physician, knows no chemistry. Perhaps it is well to tell such a student that he is not preparing to practice medicine today but in a problematical future; that no one is able to prophesy his needs, but that the best thought and experience of vast organizations of professional men resulted in a finding of great probability embodied in their listed recommendations. It has also been found effective to ask the student to read an excerpt from the medical literature. The need of a vital, functioning, chemical vocabulary soon becomes evident. A plea for intelligent cooperation directed to the "idols" may be of use. At least no exceptions have so far been found. Our medical school has sent a member of its faculty to the college students from time to time with expert advice on preparation for medical school. This procedure proved of great value, especially since the advice was supported by weighty statistics. The invaluable report compiled by Grady and Chittum in the *Journal of Chemical Education* must not be neglected here.

The student who thinks that chemistry is unsuited to his temperament must be induced to tell his conception of his temperament. If, for example, the student thinks that chemistry is base and material while he is interested in lofty ideas and their expression in the fine arts, it becomes necessary to allow the student to discover a few of the exalted passages in chemistry. If the student thinks that chemistry is too insistent upon detail, he might profit by a visit to the studio of an artist to afford an opportunity to learn of the attention to detail demanded of the artist. The student imbued with the idea that he has special abilities too valuable to be wasted on such a thing as chemistry needs to have the opportunity to discover that he will find a use for these abilities in chemistry.

Many students persist in the idea that chemistry is inherently difficult to the point of despair of mastery in spite of the Registrar's long list of students with chemistry credits earned over the years. Much of this attitude is traceable to childhood experiences. The child is given to asking many scientific questions and the failure of parents to answer them properly makes a very harmful impression. The idea takes root that because these two most wonderful people in all the world do not know the answers to these questions (as exhibited by parental irritation), these matters must be very difficult indeed. When the child later discovers that these questions are about science, a conviction arises that only super-intellects can succeed with such matters. So great is this hold upon the mind of even some teachers that they will advise their charges to shun chemistry unless they are prepared to meet failure cheerfully. The remedy lies in an exposure of the source, and the patent groundlessness of the notion that the difficulties of chemistry are insuperable.

Some students sadly misunderstand the teachers who tell them that it is a mark of intellectual superiority to question ideas before accepting them, or that it is a mark of culture to be critical, or that it is scientific to hesitate before giving assent. Such students err by excess. Instead of opening the mind to an idea, accepting it provisionally to learn of it, and then carefully testing and evaluating it, these people try to test the idea before it enters, before they are conversant with it. This is a particular case of prejudice. These people are mastered by the fear that someone is always attempting to take advantage of them. Their motto is: "Trust nobody."

Some of the blame for this situation has been laid at the door of modern advertising and the use of supercolossal superlatives. The student must protect himself against suggestion with an impervious armor. No ideas must enter lest a bad one finds its way in! If such students are invited to exert their critical faculty they should soon find a few ideas that are not wrong, a few that are valuable, a few that they should not be willing to have missed. If such students are invited to look into the record of the teacher and of the institution it is to be hoped that their confidence can be won.

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The World of Color
Part II, How Do We See?

• By Isay A. Balinkin, Ph.D., *(University of Cincinnati)*
DEPARTMENT OF PHYSICS, UNIVERSITY OF CINCINNATI, CINCINNATI, OHIO.

This article is the second of the series on Color, by Dr. Balinkin, that was begun in our September issue.

In this paper the structure of the eye is considered. Its similarity to a camera is pointed out and a number of likenesses and differences are shown. Teachers of biology and of physics will find here not only excellent teaching hints but also, probably, new information about how the eye functions.

The concluding article on "Color Measurements" will appear in our next number.

In the previous article we discussed the three S's of color perception designated by the following words: Source, Substance, and Sensation. Our topic now will concern itself with the structure of the eye, that extraordinary optical device by means of which physical radiant energy is transformed into visual perception.

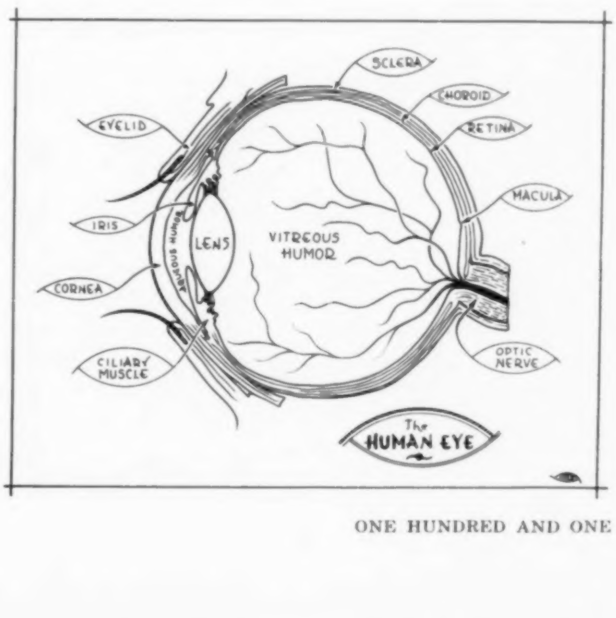
It is through our senses that we gain knowledge of the external world. Our sense of taste or touch is limited to the objects within our reach; the senses of smell and hearing can be exercised only by stimuli in relatively close proximity. But the eye is privileged to extend its domain from the innermost centers of atomic dimensions, far beyond the limits of our own world. Even the distant stars, millions and millions of miles away, call upon us to bring, with their rays, the news of the universe. Light, through vision, enables us to enjoy colors, brightness, forms, and motion. We use it, too, in the exchange of thoughts, in writing or printing. More than 80 per cent of the knowledge we possess comes to us through this single sense of vision.

The external appearance of our eyes is the most significant feature of our faces. Here is what a Frenchman, Monsieur Marion, has to say about them in his elegantly written book on Optics: "Have you never, dear reader, been enchanted with a pair of soft and gentle eyes, or with a couple of black orbs veiled with long dark lashes, or with those wondrous eyes that rival the heavens in color and depth, shedding on you rays of light whose mute eloquence was irresistible?"

The eyes are one of our most valued possessions, and Nature took proper care in protecting them well within the bony sockets of the head, with the forehead, cheek bones, and nose for external guards. Even the eyebrows serve the purpose of keeping the perspiration away from this most intricate and delicate organ. The eyelids, too, are constantly on duty to close the entrance at the slightest sign of danger, or to keep the light entirely away when we are asleep. The eyelashes serve as the advance sentinels to warn us, and to prevent the entrance of foreign matter that may discomfort the eyes. Sometimes the tear glands play a very important role. It ought to be said, however, that they are designed primarily to wash the eye so as to keep it comfortable and clean from dust.

So much for the external parts and accessories of the eyes. Let us now examine their internal structure and mode of operation.

We have a very complete and satisfactory knowledge of the normal human eye as an optical instrument. The monumental work of Helmholtz on *Physical Optics*, in three massive volumes, provides us with accurate information of the refractive processes which produce the retinal image. If we remove the eyeball from its socket we will find it to be an almost spherical globe measuring about one inch in diameter. Externally, it is covered with a white, opaque, horny shell, the front part of which, however, is transparent and shaped somewhat like a watch crystal. For perfect sight it must have a smooth, almost spherical surface. It is at this surface that the rays of light first experience their greatest deviation. We may point out here that the eye served as a pattern for the photographic camera, and in so far as the reader is probably quite familiar with the camera, I shall point out, as we go along, some of the similarities as well as some of the differences between the two.



The inner side of the eye-ball shell is directly in contact with a transparent liquid which fills a small space in front of the crystalline lens. The object of this lens is to focus the rays of light on the surface of the light-sensitive part of the eye—the retina, where the final image is formed. The crystalline lens of the human eye is a double-convex lens, and it serves a purpose similar to a lens in a photographic camera. There is, however, an important difference in focusing. In a photographic camera the lens is moved forward or backward until a clear picture is secured; in the eye the same result is accomplished by changing the curvature of the crystalline lens. When we look at a distant object the lens is flat; it becomes rounded and thicker in the center as we look at objects that are closer. This process of changing the curvature of the flexible human lens is known as "accommodation" and it is accomplished by a set of ciliary muscles which are attached to the lens.

The colored portion of the eye is the iris, located in front of the crystalline lens. The coloring of the iris determines the color of the eye, which may vary from very light blue to dark brown. The black circular spot which can be observed in the center of the iris is really an opening into the inner chamber of the eye. This aperture, called the pupil, adjusts the amount of light entering the eye to the "photographic speed" of the light sensitive retina. There is a perfect analogy between the pupil and the iris diaphragm in a photographic camera. The size of the pupil is controlled automatically by the iris mechanism in collaboration with the light-sensitive receptors in the retina. The variation in the size of the pupil can be readily observed. Actual measurements show that its diameter is less than 2 millimeters in bright sunshine, increasing slowly to 8 millimeters in darkness. This means that the relative amount of light entering the eye varies in the ratio of 1 to 20. The intensity of the external stimulus may vary in proportion of 1 to ten billion; yet our eyes still are able to discriminate a difference in intensity of illumination as small as one per cent.

The space between the crystalline lens and the back of the eyeball is filled with a transparent gelatinous substance resembling in appearance the white of egg. This substance is directly in contact with the most important and intricate part of the human eye, the membrane of the inner lining of the eye, called the retina, which serves as a screen for the image formation of objects in front of the eye. The retina may be compared to the photographic film of a camera. Under a microscope it shows a network of nerve-ends, some of which are shaped like thin rods, others like tiny cones. This resemblance is the reason for calling them rods and cones. Different in appearance, they serve different purposes as receptors of light.

The rods are responsible for our twilight vision which gives only various gradations of grays from pale to black. The rods are unable to give us chromatic sensation, a fact the reader has probably observed when the darkness of the night throws its shadow around, wiping out the glory of color. In daylight the light-sensitive material of the rods is quickly bleached out, and the rods lose completely their response to light.

When this happens the cones take on the duty of light receptors. They give us also the perception of color. There are about half a million of cones studded throughout approximately one square inch of the retinal surface. On the central portion of the retina is located a spot about an eighth of an inch in diameter, irregular in outline and yellow in color. The central portion of this yellow spot, or macula, is the "fovea centralis" which has an area equal to that of a circle a little larger than 1/64" in diameter. It is this extremely small area which enables the human eye to see clearly and distinctly. Practically all the cones can be found within the fovea centralis and its immediate surroundings. You may prove this fact to your own satisfaction by looking at a page of printed matter through one eye and concentrating your attention on a single letter. To your surprise you will discover that only a small area of the page is brought to a sharp focus, an area not larger than half an inch in diameter. It is a very fast process of scanning the whole page, combined with the power of the retina to retain the image even after the visual object is removed, that makes it appear as if we could see the whole page in a single glance.

The movements of the eye-ball are controlled by two pairs of antagonistic muscles which serve to move the eye from left to right around a vertical axis, and up and down around a horizontal axis. In addition to these, the eye can be also rotated like a cartwheel around a horizontal axis along the line of sight, by a set of two oblique muscles. The motion of the eye is always accomplished in minute jerks and during the duration of the movement no visual impression is registered. If you watch the eyes of a person reading a book you will observe that the eyes move in a series of jerks and pauses, taking in one static picture of about a word and a half and then moving rapidly to the next one.

Toward the periphery of the retina the number of cones rapidly diminishes and there is a correspondingly greater number of rods. The absence of the rods within the central portion of the yellow spot means that it is not sensitive to weak illumination. This is the basis for the precept that, "To see very weak light, it is necessary *not* to look at it." Astronomers are quite familiar with this peculiarity of vision and they know, paradoxical as it may seem, that to find a faint star they try to look not directly at the spot where they may expect to see it, but a little to one side.

If we follow the path of a ray of light as it passes through the eye we find that the image is formed in an

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Dividends From a Science Club

• **By Ernest B. Wilson, M.S.,** *(University of Georgia)*
DEPARTMENT OF CHEMISTRY, ERASMUS HALL HIGH SCHOOL, BROOKLYN, N. Y.

Do you use your science club to provide real contacts with your students? Perhaps you should.

Is the club a proving ground for new laboratory experiments and classroom demonstrations? It could be.

Do the club members prepare visual aid material? If not, why not?

Do they provide helpers for your laboratory assistants? They could.

Should sponsorship be rotated? Opinions may vary.

The suggestions given in this paper will help both teacher and student.

A teacher's lot should be a happy one. He should have an optimistic, enthusiastic outlook toward the outcome of his efforts if he is to inspire his pupils to emulate the work of previous generations.

This is especially true of teachers of science.

The teacher's attitude must be based on *real* contacts with the pupils whom he is trying to instruct. His attitude should be rooted deeper than a professional smile or pose, and it should come from something more definite than an easy assumption such as: "Everything happens for the best."

A teacher's philosophy of teaching should spring out of the courage, strength, and enthusiasm of youth as well as out of the experience and sagacity of maturity.

One of the best ways to develop and to nurture such a wholesome attitude and philosophy is to sponsor a pupil science club. The sponsoring should be undertaken because of genuine interest in the problems and personnel of the club as well as for the purpose of gaining valuable experience. No one should attempt to sponsor a club for reasons of policy, or politics, or to impress his supervisors. Such motives produce only casual contacts which have little stimulating effect on either pupils or instructor.

A teacher who is trying to become a better teacher will find few experiences happier than sponsoring a science club. The impact of the boundless imagination of youth, the variety of problems that members are eager to attempt to solve, and the dropping of classroom formality, all tend to help a teacher to recall the dreams and aspirations of his high school years. It teaches adolescent psychology in a practical, effective way.

Consider the usual group of pupils who join the chemistry club. Almost certainly one or more members will propose a fundamental investigation, such as a cure for cancer. The sponsor will agree that the problem is a good one and incidentally mention that Doctor 'X' of Institute 'X' has been working on this problem for several years and that it would be well to see what the library can offer. The pupil is soon glad to switch to a more suitable problem. This procedure usually serves to teach the pupil an important lesson without quenching his enthusiasm. Two or three will wish to study an industrial application of chemistry. Perhaps a friend or relative is engaged in chemical manufacture and has suggested a problem to the pupil. One or two budding magicians will wish to study the spectacular in demonstrations and experiments. Some may wish to attempt special analyses of minerals or other materials. But there will be several who join the club merely to be associated with another club. A few will try to evade active participation because of having joined too many clubs to give much attention to any one of those joined.

Ample, detailed information dealing with the organization and operation of science clubs is available in the literature. We make only brief suggestions because of this. Every member of the club should participate in the work of the club. Those who are unable or unwilling to co-operate should be dropped from the membership roll. Our experience has indicated that a club will thrive best where variety is the keynote of the yearly program. A judicious mixture of field trips, motion pictures, demonstrations, lectures, and individual projects will hold the interest of the pupils.

In some respects we have developed club work along lines different from those ordinarily followed. Our chemistry club has been used as a proving ground for new demonstrations or experiments which are to be introduced into the classroom schedule.

Examples of experiments developed in the club are simulation of the viscose rayon process; manufacture of cold cream, nail polish, nail polish remover, and other cosmetics; and the simulation of the Solvay process for making sodium carbonate. At present the members of the club systematically try out suggested experiments or demonstrations found in current magazines or laboratory manuals. The club has investigated about fifty such experiments during the past year. Some valuable experiments have been developed and some of those now being used have been improved. This type of work may be very valuable in making chemistry teaching better in a school.

The club has been used to prepare visual aid material. Charts showing how various chemical products

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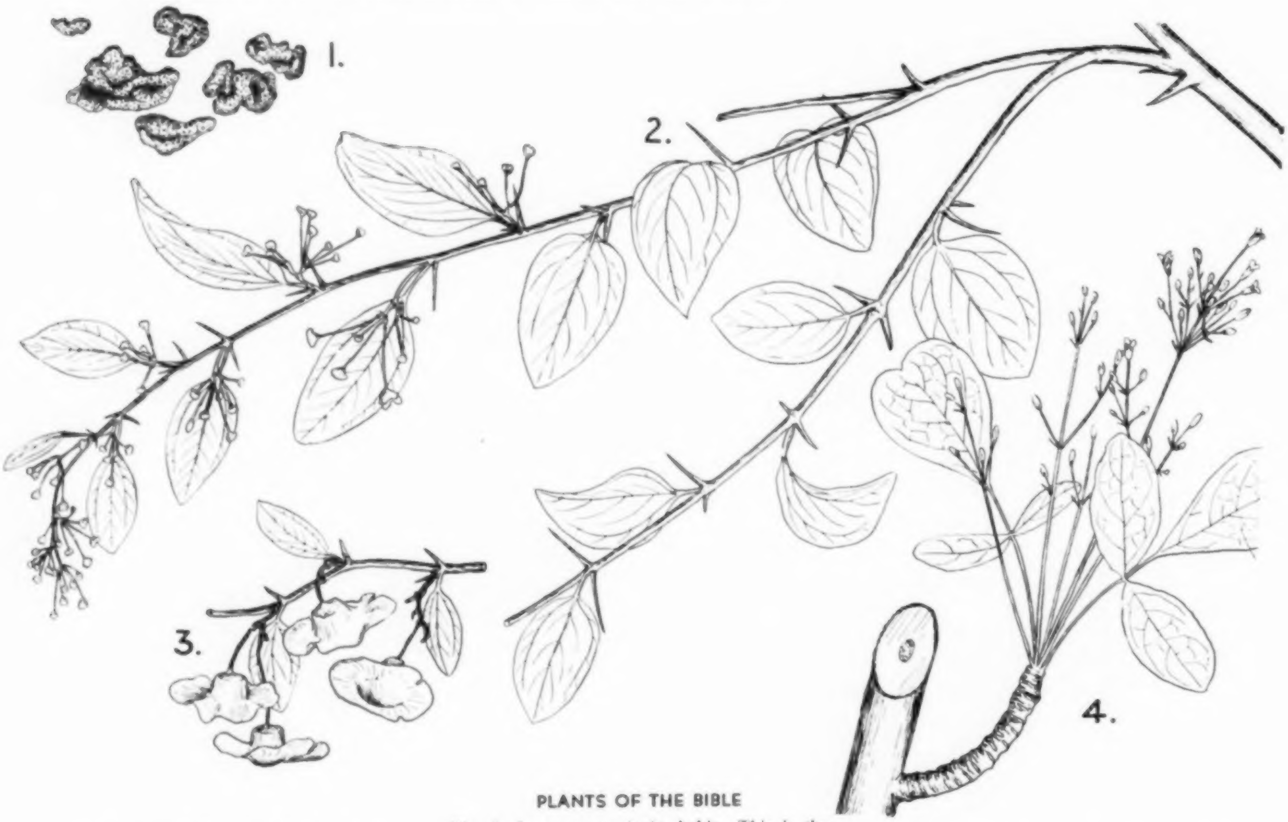
The Identification of Bible Plants

• **By John L. Blum, M. S.,** *(University of Wisconsin)*
DEPARTMENT OF BIOLOGY, CANISIUS COLLEGE, BUFFALO, N. Y.



PLANTS OF THE BIBLE

Fig. 1. *Lecanora esculenta*, habit. This is the lichen supposed by many to be the "manna" of the Jews. Fig. 2. *Paliurus aculeatus*, thought to be the plant used in making the crown of thorns. Fig. 3. Same showing fruits. Fig. 4. *Commiphora Katal*, from the gummy exudate of which commercial myrrh is manufactured. Figures about 4/5 natural size.

Are "apples" apples? Is a "lily" a lily?

When you read the Bible do you realize that some of the plants mentioned by familiar names may not be those which we know by the same names?

This paper will give you new light on the botanical identity of manna, hyssop, cockle, thorns and other plants of the Bible. You will enjoy this article.

The assignment of present day plant names to any of the hundred odd plants mentioned in the Bible is accomplished with much uncertainty.

This is due, in part, to a change in the meaning, or doubt as to the meaning of the Hebrew words, or to a change in the connotations of the plant names in English. It is due, also, to the fact that many plants may have disappeared from the flora of Palestine during the Christian Era, while others have taken their places. This is quite patent for a species of *Opuntia*, a genus which is, or was, virtually confined to the American continents; this species has now spread to the Old World, and is a very conspicuous weed over wide areas of the Holy Land.

It is impossible to identify many plants beyond the genus. For example, the Bible mentions the oaks only as such, with no specific separation. In many places in the Authorized Version, at least, an inaccuracy in translation is obvious, since the plant, as it should be identified by the English name given it, may not be known to occur in Palestine at all, or even near-by; but it may be conspicuous in the British flora. So it may be supposed that the men of the King James committee, which summoned no botanists to aid in the translation, rendered many names which were unfamiliar in

ACKNOWLEDGMENT

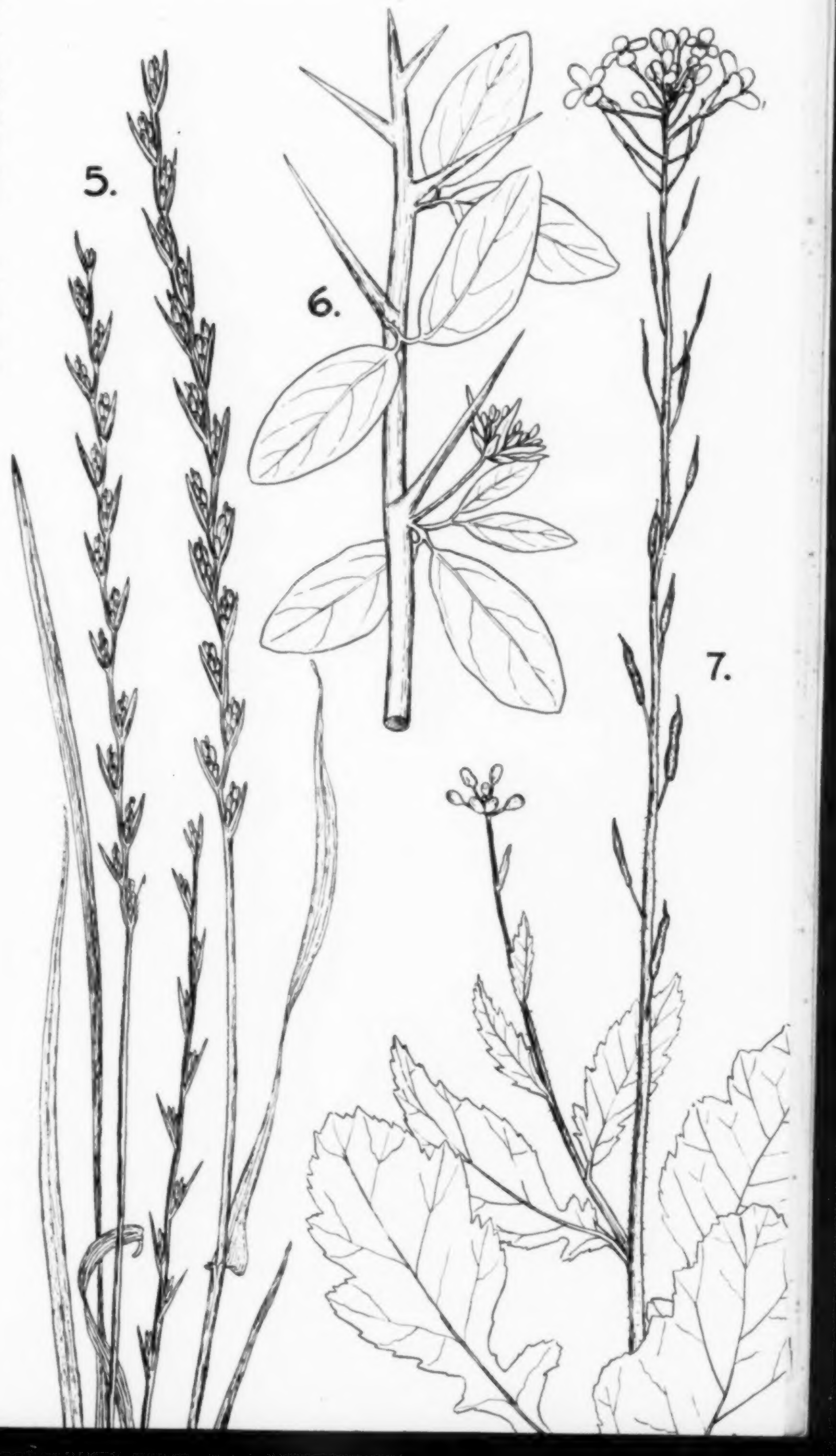
This material is taken largely from the recent publication, *Plants of the Bible*, by Dr. H. N. Moldenke of the New York Botanical Garden, now unfortunately out of print. Interested readers will find the article by Eleanor King in the March, 1941, number of the *Journal of the New York Botanical Garden* a very valuable one. J. L. B.

the Hebrew, the Latin, and the Greek, into plant names which would be generally familiar to Englishmen. In other places an inaccuracy in translation is probable, in both the Douay-Rheims and the Authorized Versions, as the following discussion suggests.

An example of the misunderstandings which have arisen involves the references to "apples" in the English translations of the Bible. Botanists have shown that apples do not grow in Palestine, probably due to the high temperatures there, and also that the apples which grow near-by in parts of Asia Minor are very small and bitter. It is known, furthermore, that only in recent years has the quality of apples in general been improved sufficiently to warrant high praise, such as the Biblical writers lavishly bestow on them. To what kind of fruit, then, can we suppose the scriptures refer, when we read apple in our English translations? Many present day scholars believe that an error in translation has substituted "apple" for what we call "apricot." The apricot is a staple food in the Near East, and one very much more likely to call forth the Biblical sentiments of praise than any true apples with which the ancient Jews may have been familiar.

Among the many plants which the Bible mentions, the "lilies of the field" might be supposed to have particular interest to botanists. And here is one of the most apparent errors in translation that is found in the Bible. It is to be supposed that the lilies of the field to which Christ referred were colorful plants, growing together in large numbers, and belonging to a common species. *Lilium* is a rare genus in Palestine to begin with, and no one Lilium satisfies all these requirements. Many other quite unrelated species of plants have been suggested by various people as the lilies of the field. *Anemone coronaria* L. is perhaps the most plausible candidate. Others are *Anthemis palustris* Reut. and *Narcissus tazetta* L. All these plants grow very commonly in the Holy Land, and having striking, colorful inflorescences, might well compare with Solomon's finery, as they are compared in Christ's simile.

There have been attempts to correlate many miraculous details of Bible history with scientific fact. Among the most interesting of these is the suggestion that the "manna" of *Exodus* 16: 13-15 and *Numbers* 11: 6-9 may be explained as certain edible cryptogams which are found in large numbers in the Arabian desert. The lichen species *Lecanora esculenta* (Pall.) Eversm. (Fig. 1), and *L. affinis* Eversm. have perhaps received most attention, because of the striking fact that they are capable of literally falling from the sky. These species grow in small irregular brown kernels that look very much like a kind of modern breakfast food. In dry weather they are often picked up by the winds, carried in the air, and deposited in very large quantities, sometimes many miles from the place of origin. They are supposed to be neither very good, nor very bad, eating, and this might very well explain the frequent murmurings of the Jews, in dissatisfaction with their limited diet. A chief difficulty with the lichen explanation of manna may well be in the quantities required to feed the wandering Jewish population. The Israelites who followed Moses in the desert were numbered in the hundreds of thousands, and they remained in the desert for many years. The quantities of this lichen that would be required are, obvi-



MORE PLANTS OF THE BIBLE

Fig. 5. *Lolium tementulum*, the Biblical "cockle." Fig. 6. *Balanites aegyptiaca*, from which balm was probably made. Fig. 7. *Brassica nigra*, the Biblical mustard, of the familiar parable. Fig. 6 after Engler and Prantl. Others taken from specimens in the Field Museum, Chicago. Figures about 9/10 natural size.

ously, enormous. As investigators have computed it, it can be shown to be within the realm of possibility that such a population was fed for this period by the natural wind migration of these lichens, so that this lichen explanation is not entirely untenable.

An equally interesting explanation of manna, however, is that it was identical with colonies of certain edible species of *Nostoc* which inhabit the desert soils. During the heat of the day this alga is scarcely visible on the ground, but during moist nights it swells up into the characteristic blue-green balls, so that where it occurs in large numbers at sunrise, it might be fancied to have fallen from the skies during the night. However, as the sun increases, it quickly dries up again. These phenomena would seem to fit very well with the account of Moses:

> *And when the dew fell in the night upon the camp, the manna also fell with it.*
>
> . . . Numbers 11: 9.

> *Now every one of them gathered in the morning as much as might suffice to eat: and after the sun grew hot, it melted.*
>
> . . . Exodus 16: 21.

It is possible that both the alga and the lichen were included in the term manna. At least it is interesting to reflect that among the few edible materials that "fall" naturally upon the earth, at least two are plants which occur at exactly the scene of the wanderings of the Israelites, and which could have supplied a large number of people with food, for a very long time.

The identity of the plant or plants intended by the many Biblical references to "hyssop" has occasioned considerable discussion and controversy, although it is even a matter of some doubt, at least for many references, if a plant is intended at all. A good example of the methods of deduction used in making these identifications is afforded by studies on the reference in Exodus:

> *And Moses called all the ancients of the children of Israel, and said to them: Go take a lamb by your families, and sacrifice the Phase.*
>
> *And dip a bunch of hyssop in the blood that is at the door, and sprinkle the transom of the door therewith, and both the door-cheeks: let none of you go out of the door of his house till morning.*
>
> . . . Exodus 12: 21-22.

This instruction, followed by the Jews in preparation for the slaying of the first-born of Egypt, implies that hyssop was a plant which could be used in the manner of a rough brush or broom. Hence, it may be supposed that it is scapose, or has a long culm of some sort, and a large, close, possibly paniculate inflorescence. Another obvious necessity is that it must grow in great abundance in eastern Egypt, where the exodus began, since a stalk must be handy to each of some hundred thousands of families on a single night. A plant which fills these requirements very well is *Holcus Sorghum* L., the commercial sorghum.

Many other plants have been suggested for hyssop, however, a prominent one being the Egyptian Marjoram, *Origanum aegypticum* L. (Labiatae). For many other uses of the word hyssop, the Biblical contexts suggest that plants with quite a different habit may be intended; and here again it is quite possible that hyssop as used in the Bible applies collectively to many different plant species, just as our words "vine" or "rush" could apply to many unrelated species.

It is believed by many that the crown of thorns was plaited from the stems of *Paliurus aculeatus* Lam., (Rhamnaceae), (Fig. 2, 3), one of the many thorny perennials which inhabit the devastated soils of the Holy Land. Another possibility is *Zizyphus Spina-Christi* Willd. (Rhamnaceae), formerly widely accepted as the authentic source tree for the crown.

All of us remember the familiar parable, in which the kingdom of heaven is likened to a grain of mustard seed,

> *Which indeed is the least of all seeds: but when it is grown up, it is greater than any herbs, and becometh a tree, so that the birds of the air come, and dwell in the branches thereof.*
>
> . . . Matthew 13: 32.

The plant intended is without much doubt *Brassica nigra* (L.) Koch, (Fig. 7), the black mustard, which now grows very commonly in the United States. We in America are not familiar with mustards which grow to such size as Christ's parable indicates, but in the Near East a very considerable size is attained, so that birds can and do nest in the branches.

Another familiar parable is that in Matthew 13: 24-30, concerning the sowing of "cockle" in a man's field, by his enemy. The cockle, (or "tares" in the Authorized Version) may be the Bearded Darnel *Lolium tementulum* L., (Fig. 5), a grass which is European in origin, but is now widely spread over the United States. Its disadvantage in a grain field is due partly to the disagreeable taste, and sometimes even poisonous properties, of any bread which it may later contaminate.

Among the plants of the Bible which are certainly not misidentified are the celebrated cedars of Lebanon, *Cedrus Libani* Loud. These noble trees are still extant on a few of the ridge-slopes in northern Palestine. The general destruction of this species in the past, however, has been a large part of the misuse which has left badly eroded and generally infertile soil over much of the Holy Land. Solomon himself was a chief offender. Like other conquerors who preceded and followed him, desirous of the valuable lumber, he laid the hillsides bare, and so spoiled his country. There are not many really old trees left, but the few which remain attest to the beauty of this tree, of which the Bible speaks in such glowing terms.

Other common plant names, such as the olive, fig, flax, and date palm, correspond with present day usage, hence are omitted from the present discussion. There are many plant products, however, which receive prominent mention in the Bible, and whose source plants are not generally known in the Occident. A very short list of these follows:

Balm is a name given to certain medicinal and healing oils much used by the ancient Jews. At present such

(Continued on Page One Hundred and Twenty-eight)

Contributions Of a Twelve Year Program in Science to the American Way of Life

• By George W. Fowler
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Every alert teacher of high school chemistry is familiar with "Chemistry for Today" and "Chemistry at Work" by McPherson, Henderson and Fowler.

Here is an opportunity to meet one of the distinguished authors more intimately. Our readers will be glad to take advantage of it.

The sound common sense evidenced in his books and in his personal teaching is exhibited again in Mr. Fowler's consideration of this important and timely topic. A recent Science Conference at Syracuse University heard the author discuss this question.

•

What content of science and method of teaching science shall we emphasize next year, and the years to come, in order that a 12-year science program will make the maximum contribution to the American Way of Life?

It becomes apparent at once, that this discussion will have no point unless we try to define the American Way of Life, however feeble that attempt may be.

During our lifetime, up to about ten years ago, our way of living might have been characterized by such expressions as "rugged individualism" and "free enterprise." In those days, each of us generally assumed he had the right to live his life pretty much in his own way. Then came the New Deal, followed by World War No. 2. Now no one is wise or bold enough to draw up specifications for and make a blue-print of America's future. All pretty much agree it will be quite different from the past or present; and many of us suspect some type of planned economy.

As viewed by the Executive Council of the American Federation of Teachers, I quote, "The crux of the problem is two-fold: (1) How can we so balance consumption and production that producers can buy back the products of their labor and thereby keep men, money and machines busy? (2) How can we adapt a world which through modern science and technology has become so highly interdependent? How can we subordinate that world to democratic ends?" Gone is rugged individualism and curtailed is "free enterprise." To regard these losses as merely emergency measures is to indulge in wishful thinking.

To us who are considering what contributions we can make to democracy through science instruction, it is of interest to note that Professor Meyer, psychologist of Johns Hopkins University Hospital, points out that scientists must convey their knowledge to intelligent non-scientist adults, if democracy is to survive this emergency. One of the ways to bring this about, is to offer for future laymen courses in science of a practical nature, the content of which is organized into such units as: Lighting the home; Heating the home; Fibers and fabrics; Science and safe driving; and Chemistry in the home. Many school systems are now experimenting with such courses.

Of further significance to us are the comments of James D. Teller, writing in the May issue of *School and Society*. He states that democracy is a way of life, not to be taught but to be lived, if it is to be understood. American school teachers, he says, have not sensed this, professors and textbook writers seldom act democratically, and therefore prospective teachers do not live democratically because they are seldom given an opportunity so to live. What Teller has said about professors and writers, I believe applies equally to some administrators, principals and supervisors. They dictate—you cooperate. But I believe it can be honestly said of our science program in Syracuse, and we have a 12-year program, that it has been done through cooperative effort. But that is another story.

The American Way of Life, as conceived by such writers as Counts, Otto, and Dewey, should be built around the principle of individual growth and the laws of social living. Absolute freedom is lost as soon as one becomes a good member of a social group. Here we have individualism but of a less rugged type than that of the founders of our democracy. It follows then that a 12-year science program can make its contribution to this new type of democracy by teachers creating classroom and community situations in which, in the words of Dewey, pupils "learn to act with and for others while they think and judge for themselves."

We can give training in cooperative effort by means of group demonstrations, science clubs, shows, fairs and congresses. In a democracy we should have facts, not propaganda. And we must learn to discriminate in, and accept and practice leadership and followship. The boys and girls, who participate in science clubs, fairs and congresses, search for facts and principles which they can demonstrate. They seek, accept and respect the leadership of teachers, doctors, engineers and others in authority, who can help them in their research. Boys and girls are thus trained in followship.

After these youngsters have secured their facts, for example: about the motions of the earth, flat feet, or why the sky is blue,—they are permitted to go before several hundred other boys and girls with scientific

exhibits, and demonstrations, to report their findings. This procedure gives them practice in leadership, and they are accepted as leaders by the group.

Leadership and followship are prime essentials in the American Way of Life.

For training in thinking and judging, we must stress the scientific method more than we have, use more individual laboratory work, sponsor essay contests, and use the differentiated or three level assignment.

The way we discipline our classes can also become a factor in training for democracy. Individual growth concurrent with social living will not result where teacher discipline is substituted for pupil self-discipline, nor where lesson getting and recitation hearing are of more concern to the teacher than are the needs and interests of his pupils. It is my experience that those teachers who do not vitalize their teaching by recognizing the interests and the needs of their pupils are the teachers who are the so-called poor disciplinarians.

It is quite possible that in the field of natural science, we are training young people for the American Way of Life quite as effectively as are our friends in the social science field, although they are taking much of the credit. Learning the preamble to the Constitution, forms of government, or provisions of a city charter may not be any better training for democracy than a scientific study of the things of science that make it really possible for all of us to live together equally; such as photographic film, and motion pictures; vitamins; vacuum tubes and radios; high grade alloys and plastics; and airplanes, rubber, gasoline, and automobiles.

We may summarize our ideas about the American Way of Life by saying that we are living, and will continue to live, in a competitive world. We must grow individually and learn to act socially. We must train for leadership and followship. And, as teachers we must expect that our pupils will imitate us. When I receive a letter from a ninth grade or fifth grade pupil, for example, saying "We want you to judge our science show", I know those pupils are imitating their teacher and that both teacher and pupil understand democracy because they are living it. *We* and *Our* are key words in training for the American Way of Life.

Let us now consider briefly, by a sampling of learning materials in a 12-year program, what might be emphasized in order to give valuable basic training for a defense emergency and future democracy by looking at the problem from three levels: Senior High, Junior High, and Elementary.

Senior High School

Youth today is air minded. Its mind is plastic and so will be much of the basic material for fabrication in its industrial world. From water, as a medium of transportation from the beginning to now, we are passing to that of air transportation. From the stone age through bronze and iron, we are coming into the age of high grade light alloys and plastics. Significant, therefore, to Senior High teachers is the following statement: "For each pilot of an airplane in the air, 12 men are needed for ground maintenance work. A defense program involving 50,000 pilots would, therefore, necessitate 600,000 mechanics of which only about one in five need not be highly skilled." Furthermore, these figures hold true approximately for each transport in the air, if we add one air hostess for each ship.

Upon the return of an airplane to its hangar, the ground crew takes over and examines and reports its condition. In the reports we find such terms as these: oil, gas, clamps, fuel, ignition, insulation, levers, rods, friction; bearings; spark, carburetor, pumps, radiators; liquid-cooled, air-cooled, brakes, tires, wings; propellor, battery, terminals, solution, hydrometer, distilled water; radio, circuit, antennae, valves, breaker points, cylinders, pistons, magneto.

Another kind of ground maintenance is that of the flight surgeon who over-hauls the pilot.

Most of the terms in these reports of mechanics and doctors are familiar to physics, chemistry, and biology teachers. How well are they understood by their pupils?

Of further significance, particularly to biology teachers, is the fact that nearly three times as many men are being rejected for America's 1940-1941 Army on account of bad teeth as were rejected for the same cause in 1917, according to Dr. C. J. King of the University of Pittsburgh. He says lack of vitamin C twenty years ago in the diet of present inductees is rsponsible. How thoroughly will teeth, vitamins and diet be taught to your pupils in 1941-1942? Further examination of pilots' reports reveals the use of such terms as barometer, altitude, altimeter, ceiling, visibility, humidity, fog, wind directions, highs, and lows. This war is being fought and will be won not only in the air but on and under water as well. Here we encounter such terms as compressed air, periscope, Diesel, torpedoes, submarine, flotation, buoyant, submerged and electrolysis.

These terms are cited as samples to show how closely our work may be tied to defense and democracy. Are we going to make sure these terms will be meaningful to our pupils as they meet them in industry and current literature? Is it expecting too much of a pupil who has completed a three-year sequence in general science, physics, and chemistry to read with fairly complete understanding a statement like the following, taken from a non-technical publication: "A magnetic mine is dropped by a parachute and comes to rest on the floor of the sea. A magnetic needle rises when attracted by the steel hull of a passing ship. The needle closes a circuit connected with the detonator, causing the bombs to explode."

If this is too much to understand,—then how much?

Is it too much to expect the boy or girl who has completed a three-year science sequence, including biology, to get the significance of the following statement selected also from a non-technical publication;

> "The germ killing effect of the mist was tested both by spraying it onto bacteria and by spraying bacteria into the mist. The test conditions were thus equivalent to those in which bacteria get into the air, either through ordinary breathing or by sneezing and coughing.
>
> The effectiveness of the mist, it is said, comes from the fact that each droplet contains the same concentration of the chemical as does the parent solution and therefore the anti-bacterial agent is enabled to act in high concentration on bacteria suspended in air. . . . The chemical is propylene glycol. . . . Spread of disease in air raid shelters and barracks . . . might be cut down . . ."

If this is too much to expect from our pupils, then how much?

Let us turn from war and aviation to light alloys, plastics and peace. We believe a study of alloys and synthetics should be emphasized in the curriculum of the immediate future. Now they are barely mentioned. Many of the articles in common use today in the home and industry are made of plastic. Tomorrow we will be wearing clothes made of plastic textiles, living in plastic homes, and traveling in plastic automobiles, boats and airplanes; built not entirely of plastic to be sure, but combined with light alloys. The future materials of industry will be light in weight and simple to fabricate since molding will take the place of welding and riveting, sawing and nailing. Test devices and formulas have already been worked out for airplane plastics by the Mellon Institute and the National Bureau of Standards.

In this discussion of contributions in the Senior High, I have used aviation, light alloys and synthetics to illustrate the general nature and trend of what to offer for learning. If I were to be mandatory, I would say, emphasize in 1941 and 1942 in all biology, physics and chemistry classes, the role played by scientific research in warfare.

Junior High School

But it is in the Junior High School where we get all the children of all the people. What shall be our program here?

General Science is exploratory as to function and environmental as to content. Man has always desired to know more about the natural world in which he lives. The early shepherds, watching their flocks by night, wanted to learn more about the stars; and we are equally anxious to learn more by looking at them through the 200-inch telescope. And not only that,—we are watching viruses through the electron microscope.

In exploring his surroundings, the Junior High pupil studies the stars over his head, and learns about the rocks and soil under his feet, the air he breathes, the water he drinks, the food he eats; his health; and fire as a friend and as a foe. He learns through simple explanations and experiences rather than by formal definitions and lectures; from observing, experimenting and consulting authority, rather than by memorizing passages in a textbook; and by talking and writing about, and drawing what he actually experiences. Ideas thus have reality.

In the Junior High School the pupil is trained in orderly thinking through breaking up an experimental situation into object, materials, method, observations, conclusion and application. Here, however, is the weakest feature of junior high teaching.

There is too much dictation in too many classes, and scientific thinking is not the result. Here is a case in point: a class in eighth-grade science was working on the problem *what makes atmospheric pressure?* They decided that weight of air, altitude, amount of moisture in and temperature of air were important factors. During the discussion a boy said he believed that air exerted pressure, but not very much. "How much?" said the teacher. "About a pinch of sand", was the reply. "Where did you get that idea?" asked the teacher. "In a seventh-grade experiment. It took a pinch of sand to balance the balloon after filling it with air", said the boy. It is evident that the learning situation in the eighth grade was good. In the seventh grade it was poor, which might be expected from dictation. But in all fairness to science teachers in the Junior High, it should be said that in comparison with the grades above and below, theirs is the most difficult problem.

General Science also offers an opportunity for the teacher to encourage the collecting habit, which leads to classification, an important step in scientific thinking, and to sponsor hobbies. I visited recently a national defense aviation training school for young men who in ten weeks are taught riveting, fabricating and assembling. Nearly all of the men in this school had not graduated from high school but practically all had completed the ninth year. I asked the foreman about the needs of their trainees. They need to know something about the nature of pure aluminum and its alloys, duralumin and magnalium; they need to know something about the nature of electrolysis and how to prevent it when aluminum is welded to steel. They need to know how to read scales. And they must think.

One of the questions asked of the boys who apply for the course is "Have you a hobby?"

We can make our contribution to defense and democracy in the Junior High School by teaching a science content that is functional, by a method that trains pupils to observe, and to think. We can develop in our pupils an attitude of open mindedness, increase their belief in a cause and effect relationship, and help them acquire the habit of suspended judgment.

(Continued on Page One Hundred and Twenty-two)

Homemade Laboratory Equipment

• By Carl R. Stannard, M.S., *(Syracuse University)*
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Here is a how-to-do-it article of unusual merit.

It describes high school pupil work that would be highly creditable to college students.

No boy who worked on these projects will ever forget the scientific principles involved. This is good teaching.

Teachers will be interested in the observation that despite its merits, homemade equipment is not always the least expensive in either time or money.

●

In terms of high school science teaching, it appears to many that the personal application of principles best brings about true understanding.

Student-built apparatus is one means of attaining this whenever it is justified or possible, but it must be made clear that such equipment is not always the least expensive in either time or money. The science students in our school have tried to build various kinds of equipment according to their interests, either for the laboratory or for personal use. They have had considerable success. Some of their more interesting achievements are here illustrated.

Several students who were keenly interested in electricity and its allied fields built an organ. It might be called a photoelectric or a stroboscopic organ. The front view in Figure 1 shows the keys taken from an old piano. Each key, operating a simple contact switch underneath, lights a 6-volt automobile headlight bulb located behind one of the rings of holes in the disc, the rear view of which is shown in Figure 2. The disc, mounted on the shaft of a vacuum cleaner motor in series with a rheostat, rotates so as to chop the light of any one of the 21 bulbs, each of which is located behind a different ring of holes. The aluminum disc, 18" in diameter as we designed it, has 707 holes arranged in successive rings. Set up in one side of the room, it casts chopped beams on a photoelectric cell connected to an amplifier.

Probably the easiest means of setting up the receiving end is by removing the photoelectric cell from a 16 mm. motion picture projector and extending its electrical connections so the cell may be placed in a favorable position back of a large condensing lens. Figure 3 shows the male plug (which replaced the photoelectric cell in our 24 B Victor projector) connected by a shielded cable to a wood-connected female socket for the photoelectric cell, so that the setup can be quickly changed from a sound projector to an audible light receiver.

After proper focusing, the disc is set in motion and tuned by operating the rheostat. Pressing a given key lights a given bulb, thus setting up pulsations of light depending upon the speed of rotation and the number of holes in the ring. Any number of notes may be set up simultaneously. Actual count of the holes in the rings shows clearly the law of harmonious sounds. The siren effect can be demonstrated, and if an electric fan is used as an additional chopper, various sound effects, such as that of airplanes, can be produced.

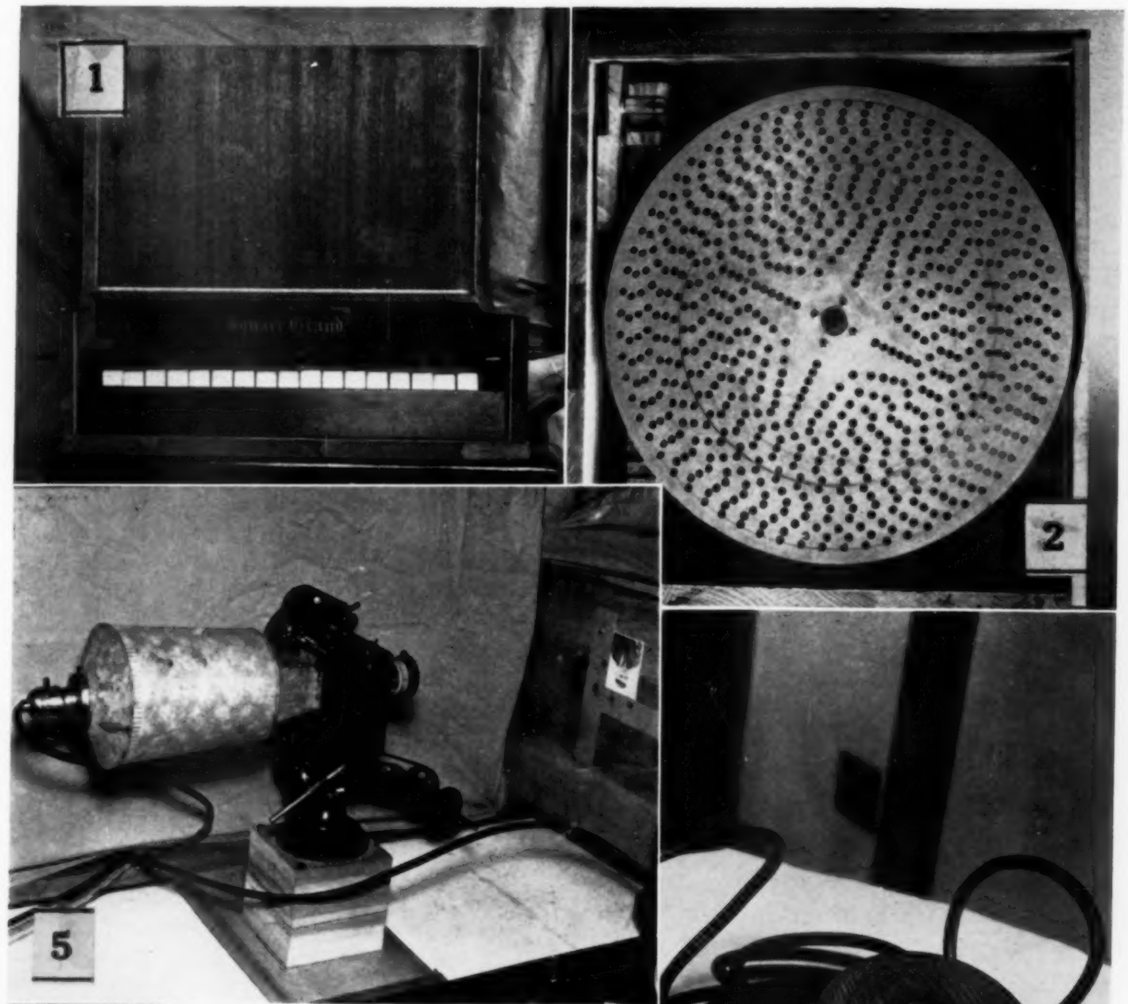
Using a 50-watt lamp beam, double-chopped by two electric fans controlled by rheostats and received by the photoelectric cell and amplifier, one can show beats of sound effects very well. Excitation of the receiver by fluctuations of a neon bulb connected across the output of a public address system will demonstrate audible light. Voice or music can be transmitted a distance of many feet.

It should be emphasized that some boys who are interested in the construction and operation of such instruments lack the necessary money for materials. They may need a small amount of direction. Many boys find such work an outlet for their energies. At the same time they may offer good service to pupils less advanced. Of those who have worked on this photoelectric organ, one is now a radio operator on a coastwise tanker, another a business-machine trouble shooter, another a motion picture projector operator, and still another is studying in an electrical institute.

Lenz's law can be shown by a laminated iron core wound with several hundred turns of No. 10 copper wire. As shown in Figure 4, an aluminum ring is placed around the end of the core. When the switch is closed the ring is forced upward.

For the past few years our student work has been concentrated quite largely on photographic activities, both still and movie. All school photographs and motion pictures are planned and exposed by the students. The photographs accompanying this paper were made by students. The visual education films are operated by the same group. In that work, a need has arisen for varied equipment. Figure 5 shows a 35 mm. silent projector which has been made over into a 35 mm. enlarger for still pictures. The change from one negative in a strip to the next negative is quickly accomplished by means of a crank. With this arrangement we are able to take several poses of each individual in the school at a negative cost of about one-half cent per negative. The strip, after development and drying, is inserted in the enlarger and the final prints are made.

(Continued on Page One Hundred and Twenty)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Scholarship and Geology in the United States

• By Arthur R. Barwick, Ph.D., *(New York University)*
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In this, the second and concluding part of this paper on the development of geology in the United States, Dr. Barwick discusses the most noted men who have worked in the field and their accomplishments.

This paper has considerable importance as an historical record.

We are pleased to be able to publish it.

PART II

The field of geology, in its largest sense, is divisible into physical, historical, and economic groupings. All of these have been associated with illustrious workers in the United States. The writer, who has had experience in teaching the history of geology for many years, and who has studied the bibliographies of many of our contemporaneous American scientists, has chosen about two hundred and fifty names of geologists, living and dead, that appear to be outstanding. Time and space will not warrant the specific mention of even half of these, but the work of classification seems to establish, fairly well, the major sources whence their training came.

Although many of the earliest workers were often self-trained hobbyists without definite collegiate associations, it becomes readily apparent that the universities of Yale, Harvard, Chicago, Johns Hopkins, Columbia, and California have been the greatest producers of outstanding men in this field. Second only to these as producers of eminent American geologists are Stanford, Princeton, Cornell, Wisconsin, Michigan, and Minnesota. Beyond these the choice becomes somewhat more involved, but the state universities, where state geological surveys are established and subsidized, seem to head the list as would naturally be expected, particularly in the mining States.

Physical Geology can be roughly divided into: structural and dynamic geology; mineralogy; petrology and petrography; and physiography, glaciology, and hydrology. Among the earliest pioneers in this division we find Benjamin Silliman (1779-1864) of Yale, Amos Eaton (1776-1842) of Rensselaer Polytechnic Institute, and Edward Hitchcock (1813-1864) of the First Geological Survey of Massachusetts, all of whom were somewhat Wernerian in their tendencies. The dawn of strictly modernized methods of teaching geology dates back to Sir Charles Lyell's famous text of 1830 entitled *Principles of Geology*, and the first American geologists strictly to heed its inductive teachings were James Dwight Dana (1813-1895) of Yale; Henry D. Rogers (1808-1866) of Pennsylvania and the First Pennsylvania Geological Survey; and David Dale Owen (1807-1860) of the Wisconsin and Ohio Territorial Survey.

Toward the close of this period, too, we find the name of Joseph Leconte (1823-1901), a student of Agassiz at Harvard, in the field of dynamic geology; Alexander Winchell (1824-1891) of Michigan in structural, and Major J. W. Powell (1834-1902) in charge of the Survey of Western Territories. Then followed the brilliant work of Nathaniel Shaier (1841-1906) of Harvard and Thomas C. Chamberlin (1843-1928) of Chicago. The short but outstanding career of Joseph Barrell (1869-1919) of Yale should be mentioned at this point, together with that of the grand old man of Stanford, Bailey Willis, who still survives.

The United States can also boast of two famous pioneers in the field of isostasy and geophysics: Clarence E. Dutton, U. S. A., (1842-1912), and J. F. Hayford (1868-1925) of The Coast and Geodetic Survey. Among contemporaneous workers at the Geophysical Laboratory, D. C., are Leson H. Adams (Ph.D. Illinois) and, formerly, C. N. Fenner.[3] In the field of vulcanology, the names of E. O. Hovey (1862-1924), Thomas A. Jaggar, and Arthur L. Day (Ph.D. Yale), might be mentioned. Active workers in the field of structural geology at the present time are C. H. Behre of Northwestern; Walter H. Bucher of Columbia University; Rolin T. Chamberlin of Chicago; Andrew C. Lawson and G. D. Louderback of California; Chester R. Longwell of Yale; and James B. Macelwane, S.J., of the University of St. Louis.

In the field of mineralogy and crystallography probably the most outstanding name of the country is that of Edward Salisbury Dana (1849-1935) of Yale, the writer of that famous work entitled *System of Mineralogy*. Yale also contributed such other great mineralogists as Benjamin Silliman, Jr. (1816-1885); S. L. Penfield (1860-1906); James Dwight Dana, and William E. Ford (1878-1939). Four chemists with mineralogical leanings may be mentioned in the names of J. Lawrence Smith, Wm. F. Hillebrand, Frank W. Clarke, and H. S. Washington. Among the older and more famous workers of the present time are Charles Palache of Harvard; Austin F. Rogers of Stanford; Fred E. Wright of the Geophysical Laboratory, D. C.; Clarence Ross and Waldemar Schaller of the U.S.G.S.; Wm. S. Bayley of Illinois, and H. P. Whitlock of the American Museum of Natural History. In the line of gem minerals, the names of George F. Kunz and E. H. Kraus are noteworthy. Among the younger workers of note at the present time, the name of Wm. F. Foshag of the U. S. National Museum, Washington, D. C., should be mentioned.

In the field of petrology and petrography one finds, among the older workers in this country, the names of Wm. O. Crosby (1850-1925); Whitman Cross (still living); Joseph S. Diller (1850-1928); Persifor Frazer (1844-1909); James Furman Kemp (1859-1926) of Columbia; G. P. Merrill (1854-1929) of the U. S. National Museum; Louis V. Pirsson (1860-1919) of Yale; and J. E. Wolff, emeritus professor at Harvard. Joseph P. Iddings (1857-1920) of the University of Chicago was internationally famous. Among the older surviving petrologists and petrographers, the names of Florence Bascom of Bryn Mawr, Clarence Ross of the U.S.G.S., Reginald Daly and E. S. Larsen of Harvard, Albert Johannsen of Chicago, Alfred C. Lane of Tufts, Edward B. Mathews of Johns Hopkins, and Alexander N. Winchell of Wisconsin, should be mentioned. Other workers of merit in this field are N. L. Bowen of Chicago, Arthur F. Buddington of Princeton, Frank F. Grout of Minnesota, H. E. Merwin of Carnegie Institute of Technology, and Wm. J. Miller of the University of California.

The field of physiography lies along the borderline of geography and its most famous devotee in this country was Wm. Morris Davis (1850-1934) of Harvard and Stanford universities. G. K. Gilbert (1843-1918) is famous for his interpretation of the Basin Range structure of the West. At about the same time R. S. Tarr (1864-1912) was carrying on his brilliant researches in physiography at Cornell University. Among the older living physiographers of note are found Wallace W. Atwood of Clark University, Wm. Bowie of the Coast and Geodetic Survey, N. M. Fenneman of Cincinnati, H. E. Gregory (Yale) of Hawaii, Robert T. Hill, formerly of the U.S.G.S. and once a lecturer at this University[4], Wm. H. Hobbs of Michigan, and Rollin D. Salisbury of the University of Chicago. Following closely in the footsteps of these we note Eliot Blackwelder of Stanford, J. Harlan Bretz of Chicago, James W. Goldthwaite of Dartmouth, Morris M. Leighton of the Illinois Survey, and Oskar D. Von Engeln of Cornell. Douglass Johnson of Columbia is justly famous for his work on coastline development. Francis Shepard of Illinois has been winning world recognition for his explorations of the topography of the ocean floor.

The father of American glaciology is the famous Swiss pioneer in this field, Louis Agassiz (1808-1873) of Neufchâtel who was given a chair at Harvard in 1847. Among the more noted of older American glaciologists one might mention George F. Wright (1838-1921); Warren Upham (1850-1934); Herman L. Fairchild of Rochester; Frank Leverett of Michigan; I. C. Russell (1852-1906); and H. F. Reid of Johns Hopkins. F. E. Matthes of the U.S.G.S. and Col. Lawrence Martin of the Library of Congress have been outstanding in glaciology along with other important lines of endeavor.

Lastly, in the field of hydrology, one finds a number of American names that deserve especial mention. Both the past Director of the United States Geological Survey, George Otis Smith, and the present incumbent, W. C. Mendenhall, were workers in this field. Oscar E. Meinzer (Ph.D. Chicago), of the United States Geological Survey is noted for his writings on underground waters, and F. E. Matthes for his work in the Mississippi Valley. Chester K. Wentworth (Ph.D. Iowa) has been doing creditable work on the Board of Water Supply in Honolulu, Hawaii, while Kirk Bryan of Harvard is an active worker in the United States proper.

The second great division of geology is Historical Geology which involves the fields of stratigraphy and paleontology. Pioneers in the more general aspects of this division are Ebenezer Emmons (1799-1863), famous in connection with the great Taconic controversy, and Wm. B. Rogers (1804-1882) of Virginia University and Massachusetts Institute of Technology who turned out fine stratigraphic work in Virginia and Pennsylvania. Among the older workers in structural and field geology are Samuel Calvin (1840-1911) of Iowa, and N. H. Darton, Arthur Keith, and C. S. Prosser (1860-1916) of the United States Geological Survey. Gilbert D. Harris of Cornell has done creditable work on the stratigraphy of the Caribbean area. More recently, this field of endeavor has been covered by J. P. Buwalda of California Institute of Technology, Kirtley F. Mather of Harvard, W. D. Mead of Massachusetts Institute of Technology, Raymond C. Moore of Kansas and Arthur C. Trowbridge of Iowa. The Rev. Stephen Richarz of Techny, Illinois, and China, was doing fine work at his untimely death.

The field of paleontology is so large it must be divided into the sub-fields of invertebrate paleontology, vertebrate paleontology, and paleobotany. As the study of the last is somewhat newer and more limited, it will be considered first. Probably the oldest of outstanding paleobotanists of the United States was Leo Lesquereux (1806-1889) who worked on the coal flora of Pennsylvania. John Strong Newberry of Columbia University (1822-1892) was also a paleobotanist of note. After his death some of his works were carried to completion by Arthur Hollick, a student of the Staten Island Cretaceous and himself a paleobotanist of note. Two other early workers were Wm. M. Fontaine (1835-1913) of the University of Virginia, and the indefatigable Lester Ward (1841-1913) of the United States Geological Survey, a world famous sociologist in his later years. Then followed the two famous Whites, Israel C. and David, whose work on coal plants became internationally known. During this time Frank Knowlton (1840-1926) was the oracle of the Tertiary who, upon dying, bequeathed this great honor to Edward W. Berry of Johns Hopkins. George R. Wieland of Yale has won world renown for his classic work on fossil cycads, while E. C. Jeffrey is noted for his micro-paleontologic research on coals. Among the younger contemporaneous writers on Tertiary angiosperms are Ralph W. Chaney of California and Roland W. Brown of the United States Geological Survey.

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Quality Milk

• By Charlene Branon, B.S., *(Trinity College, Burlington, Vt.)*
CONTROL LABORATORY, H. P. HOOD & SONS, INC., ST. JOHNSBURY, VT.

This is an account of clean milk.

Few persons not actually in touch with the work realize the careful scientific treatment that is given to the milk supplied to cities. To insure that milk shall be of good quality when it reaches the consumer requires the application of a number of tests by skilled workers.

Miss Branon here takes you behind the scenes.

The Director of the Hood Laboratories was called upon recently to present a paper entitled "What is meant by Quality Milk?" After searching the dictionaries unsuccessfully for a satisfactory definition of the word "quality" used in this sense, he asked a practical-minded salesman to define "quality milk." The reply was, "Quality milk is the only kind of milk people will buy these days." This may not be a definition suitable for a dignified dictionary, but it hits the nail on the head.

If we compare the milk sold at the beginning of the century with the product available to the public today, it is evident that great advances have been made, advances which have not come about by chance but which represent the lifetime effort of the pioneers who championed the cause of good milk. The demand for milk of better and better quality is a natural result of the educational work that has been done during the past three decades by the medical profession, by public health departments and by nutrition specialists, as well as by the dairy industry itself.

The promotion of the sale of milk and other dairy products has always been based upon the sound assumption that milk, if it is pure and clean and safe, is unsurpassed in meeting the physiological demands of human nutrition. Unfortunately, the dairy industry sometimes receives bad publicity because of the epidemics traceable to impure milk that occur each year. Even now the number of milk-borne epidemics reported annually in the United States is rarely less than forty. Such epidemics, harmful as they are, serve to impress upon the public mind even more strongly than ever the importance of demanding quality milk, and each year it becomes increasingly difficult for dealers to sell milk that is not backed by a quality control program based on sound scientific principles.

At first, the industry resented demands for improvement. Later, realizing that the public was making honest demands, dealers were stimulated to compete with each other in supplying high grade milk to their customers. Whenever a progressive dealer inaugurated a program of field inspection and laboratory testing, the other dealers soon had to follow suit. The result was milk of increasingly good quality. Competition within the industry still continues. If the curve of past experience of increasing demand for quality milk is projected into the future, we may confidently expect that it will always become more and more difficult for dealers to sell anything but a quality product.

There are a number of milestones in the development of laboratory methods for controlling the sanitary quality of market milk. We will mention but a few.

Shortly after the advent of bacteriology in the late nineteenth century, the attention of research workers became focused on the importance of good milk as a factor in public health. Much of the milk sold at the time contained bacteria numbering in the millions, and the dairyman's major problem was to make delivery before the milk could sour. It is not surprising, therefore, that emphasis soon was placed on methods of determining bacterial numbers.

The studies of the sources of bacteria in milk by H. W. Coon at Middletown, Conn., as early as 1889, had a stimulating effect. An important early publication in the field was that of Sedgwick and Batchelder in 1892. The results of their bacteriological examination of Boston milk first brought to the public a realization of the importance of dairy sanitation. The beginning of "certified" milk in 1893 by Dr. Croit and Stephen Francisco at Montclair, N. J., involved the use of laboratory methods for controlling the number of bacteria present. Montclair is said to have been the first city in America to undertake regular bacteriological examinations of its milk supply. The first positive action in New York City came in the late nineties when the Board of Health prohibited the sale of milk except under a permit and subject to the rules and regulations of the Board. From that time on the right of officially constituted boards of health to control the sanitary quality of municipal milk supplies has never been successfully opposed.

Shortly after the turn of the century W. H. Parks published a paper entitled, *The great bacterial contamination of the milk of cities. Can it be lessened by the action of health authority?* It served as a very practical circular of information regarding the way in which bacteria enter and grow in milk. By the time the Laboratory Section of the American Public Health Association undertook to prepare the first *Standard Methods Report* on bacteriological methods for the examination of milk, a number of cities had become interested in the problem. Boston had established a

count of 500,000 per cc. as the maximum permitted. By 1901, a few dealers in Boston and elsewhere had started routine monthly, or occasionally, more frequent analyses. These examinations consisted of agar plate counts and in certain cases the microscopic examination of centrifuged sediments for leucocytes and streptococci.

A number of procedures were devised to enumerate bacteria in milk since the numbers could be used as an index of care in production. At first, a known amount of milk was placed in a tube containing a measured volume of broth, and, after shaking, a measured quantity of the contents of this tube was mixed with broth in a second tube. A third dilution was made in the same way, and so on. From a suitable calculation considering the dilution, the number of bacteria in the original milk could be determined. Later, gelatine was added to the broth and it was poured out on to flat pieces of glass to solidify. The bacteria were caught in place and colonies developed upon incubation. This method gradually led to the use of agar as a solidifying agent and to the use of the covered petri dishes now employed.

Changes and improvements have been made continually in methods and technique. Eventually the demands for uniformity of laboratory reports brought about the present day *Standard Methods*, a publication now in its seventh edition that has become the "bible" of milk laboratories.

When laboratory testing was inaugurated, there was, of course, no uniformity. Various methods were employed. In order to compare results from the different laboratories it was necessary that methods and procedures should be standardized. A committee was chosen to select and compile suitable standards, the chief characteristics of which were to be accuracy, and simplicity of media and method. The members of the committee considered all the available methods, chose from among them the most practical ones, and made them available to all laboratories. In this way uniformity was achieved.

At present the procedures outlined in *Standard Methods* are followed by all laboratories under State Department of Agriculture and Board of Health supervision. The equipment and media to be used, as well as the methods to be employed in sterilizing, all are according to rule.

The routine of milk examination is interesting. I operate what is known as a Quality Control Laboratory for one of the larger dealers supplying milk to the Boston market. At the receiving station samples of each farmer's milk are taken according to specifications in sterile bottles that have been shipped to the station from the central laboratory. After being marked with an identification number they are transported immediately to the laboratory in suitable cases, well iced. When received, they are plated at once according to the standard agar plate method for making bacterial counts.

This consists in counting the number of visible bacterial growths or colonies in and on the nutrient agar. To achieve greater accuracy all milk is diluted. One cc. of milk is mixed with 99 cc. of sterile water, making a 1:100 dilution. After the dilution has been well shaken, 1 cc. is put in a properly identified sterile petri dish and mixed with nutrient agar, the medium for bacterial growth. After allowing the agar to harden, samples are incubated for 48 hours at 37° C., before the count is made.

At the end of the incubation period the number of colonies visible under a reading glass are counted, thus giving what is known as the bacteria count. A record of the counts is sent to the field man at the receiving station to be kept on file for State officials. The field man contacts the farmer and aids him in remedying conditions and lowering his count. According to Board of Health regulations, such counts are made on every dairy twice a month, that is, on every dairy producing market, or Grade B, milk.

The standard plate count on raw milk must not exceed 400,000 per cc. and for milk that has been pasteurized at 143° for 33 minutes before plating, the maximum count allowed is 20,000 per cc. On dairies producing grade A milk, which is of superior quality and sells at a higher market price, samples must be taken twice every week, or eight times per month. The standards are likewise higher, allowing a count of only 50,000 for raw samples and 5,000 for those which have been pasteurized.

Besides the tests made by the agar plate method, once every month, the milk from each dairy undergoes a microscopic analysis. This is for the purpose of detecting streptococci, or infection in the herd. Upon finding any dairy so infected, the dealer must refuse to accept the milk, until the cause has been identified and removed.

There has been some discussion of late in favor of substituting microscopic analyses for agar plate counts. There are factors definitely in favor of doing so. The results can be known much sooner. The period of incubation is avoided. The types of bacteria are recognized, thereby indicating the probable cause of high bacterial counts in raw milk. Also there are types of bacteria which do not develop colonies on plates prepared according to standard methods, and which would be detected under the microscope.

Because of the eye-strain and tediousness in using the microscope, bacterial counts are not usually made this way. However, milk can be readily classed as excellent, good, or unsatisfactory. Also, from a "smear" one is able to determine the cause of a high count; that is, to attribute it to faulty cleaning of equipment on the farm, to improper cooling, or to an infection in the herd.

The microscopic analysis is made as follows: 1/100 cc. of milk is placed on a glass slide with a platinum loop

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NEW BOOKS

Photograph by Robert Turiff Hance

Principles of Microbiology

• *By* F. E. COLIEN, Creighton University, and E. J. ODEGARD, College of Saint Teresa. C. V. Mosby Co., St. Louis. 1941. 444 pp. $3.00.

This attractive textbook emphasizes the applications of microbiology to the nursing sciences and to disease prevention. Consequently it rightly places greater stress on what microorganisms do than it does on their classification, cultural characteristics, or methods of identification. "The subject matter has been arranged, with one or two exceptions, to meet . . . recommendations of the Curriculum Committee on Education of the National League of Nursing Education."

The book is well illustrated, several plates being in color. The field of medical microbiology is covered appropriately, and there are chapters dealing with the destruction of microorganisms, infection and immunity, and microbiology in relation to water and milk. An Appendix includes sections on culture media and suggested laboratory exercises and demonstrations. There is a glossary of technical terms. *E.V.*

Comparative Chordate Anatomy

• *By* CLAIR A. HANNUM. Stanford University Press, Stanford Univerity, 1941. v + 211. $2.00.

An unusually well written conventional description of comparative chordate anatomy intended for use in the laboratory. Except for lack of illustrations this paper-bound book will be entirely adequate as a text for the course as well as a guide for laboratory observations. The reviewer hopes that some day directions for the finding of anatomical details will not be hidden in paragraphs, but will be set out clearly in an arrangement that will make them more easy to read and to follow on the specimen. *R.T.H.*

The Art and Science of Nutrition

• *By* ESTELLE E. HAWLEY and GRACE GARDEN. The University of Rochester School of Medicine and Dentistry. C. V. Mosby Company, St. Louis. 619 pp. 1941. $3.50.

The art of this basic exposition whets the appetite for knowledge of the use of food by a tempting color photograph, on the jacket, of an attractive meal. From this untouchable display of good food, well prepared and arranged, on through the book the reader is presented with a remarkably complete and interestingly written story of the why and wherefore of what we eat, or should eat if we do not. The jacket announces this as a new book. It is, from cover to cover. Intended chiefly for dietitians it is real reading for any one who has heard of calories, vitamins, and of eating to live. *R.T.H.*

Laboratory Exercises in Physical Geography

• *By* M. H. SHEARER, Westport High School, Kansas City, Mo. McGraw-Hill Book Company, Inc., New York. 1941. 139 pp. $1.00.

A paper bound, lithoprinted, consumable laboratory manual designed to accompany "The Earth and Its Resources" by Finch, Trewartha and Shearer (reviewed in *The Science Counselor*, Vol. VII, No. 3.) Fifty-two interesting exercises are arranged in 19 chapters. The small amount of laboratory equipment needed is listed.

This manual appears to be as well done as the text it supplements, which is high praise. *H.C.M.*

Microbiology Laboratory Manual

• *By* PAUL W. ALLEN and GEORGE M. CAMERON, University of Tennessee. C. V. Mosby Company, St. Louis. 1940. 227 pp. $2.00.

This lithoprinted manual presents bacteriology as a part of biology. It uses well known facts as a foundation upon which to build a scientific knowledge of microbic life. Its aim is stated to be "to develop the student's understanding of such phases of microbial life as will aid him in his everyday life as an American citizen."

Twenty-four well selected laboratory studies provide ample material for a one-semester course. Numerous notes, explanations, illustrations, and review questions are supplied. The lengthy bibliography should lead the more ambitious student (and Instructor) to a broader knowledge of the subject. In the Appendix are numbered notes for guiding the student in the various studies. *E.V.*

Handbook of Communicable Diseases

• *By* FRANKLIN H. TOP and COLLABORATORS. C. V. Mosby Co., St. Louis. 1941. 682 pp. $7.50.

This book is intended as a textbook or handy reference for those whose professional duties necessitate contact with communicable diseases. Such persons should find it an invaluable aid.

The first section deals with general considerations applicable to communicable diseases. It is well done. The second section is devoted to the diseases themselves, classifying them by common portal of entry. Each important disease is treated adequately as to definition, history, infectious agent, epidemiology, immunity, pathology, symptoms, clinical types, complications, differential diagnosis, prognosis, treatment, nursing care, and prevention. The chapters on pneumococcic pneu-

monia, tuberculosis, syphilis and gonorrhea are especially complete for a handbook. Bibliographies are given at the ends of chapters. The third section of the book contains 23 tables and a glossary of medical terms. There are 73 text illustrations and ten color plates.

In preparing this book the author has had the help of numerous collaborators, each a specialist in his own field. *E.V.*

The Chemical Formulary

• *By* H. BENNETT, Editor-in-Chief. Chemical Publishing Co., Inc., Brooklyn. 1941. 674 pp. $6.00.

A repository of manufacturing information of varied nature covering many fields. More than 700 pages are crammed with tested formulas valuable to the layman, manufacturer and chemist. If you are interested in the preparation of adhesives, cosmetics and drugs, beverages, inks, paints, farm and garden specialties, foods, polishes, cleaners, lubricants, laundry supplies and a thousand and one things of like nature, here is your best buy. The use of even a single formula might save you the cost of this book immediately. These are new formulas not found in any of the four preceding volumes. The five volumes are not repetitive. *J.F.M.*

Essentials of Pharmacology and Materia Medica for Nurses

• *By* ALBERT J. GILBERT, M.D., and SELMA MOODY, R. N. C. V. Mosby Co., St. Louis. 1941. 251 pp. $2.25.

This book has fulfilled the purpose set up for itself —"To present the facts and theories of Pharmacology and Materia Medica for nurses in a lucid, concise form, adapted to the limited time available for the course in many nursing schools." The material covers the important drugs and the important points on all the drugs mentioned. It furnishes excellent illustrations. It is too brief, however. It contains no explanatory material. It could well be used as a textbook, but reference books for more inclusive study would seem to be essential.

Ruth D. Johnson, School of Nursing, Duquesne University.

Food for Thought

•

1. Am I planning my *questions* before class, writing them out if necessary, so that I *lead* from one point to another without omitting a single step that will aid in logical development? Am *I* doing the thinking, or am I leading the *student* to think? Am I ruining my progress as a teacher, and the student's progress as well, by *telling*, and then "drilling it in"?

☆ ☆ ☆

2. Do I make sure, by teaching before the need for them arises in the study period, that my students have the background and the vocabulary necessary to understand the assignment?

☆ ☆ ☆

3. Am I *reteaching* if ten per cent of the class fail to pass on any item?

☆ ☆ ☆

4. Do I give individual attention to that ten per cent *immediately*, before giving aid to students who have a passing mark, Am I doing it in the period immediately following the test? Do I use the entire period if necessary? Have I provided work for the upper section while I am doing this? Did I lay it out in my lesson plan *before* I came into class, so that no time is wasted?

☆ ☆ ☆

5. Am I planning *concrete* presentation wherever possible?

☆ ☆ ☆

6. Am I using the same old plans, or am I adding new illustrations, changing the order to insure more logical progress, and finding new methods of adding interest? Am I making even drill work interesting? Is my attitude "Come on, this is fun! You can do it!" or is it "You are going to get this because I say so, whether you like it or not."

☆ ☆ ☆

7. Am I presenting my new material, setting to work those who can do the assignment, and *immediately* reteaching those who can't? *Do I keep at it until they can?* Do I immediately reteach failures as an ordinary daily procedure?

☆ ☆ ☆

8. Do I attack "hard" principles by myself, using plenty of time to find out *why* they are hard? Do I then analyze the particular spot that offers difficulty and *arrange a corrective procedure* to overcome each difficult item? Do I realize that "hard" things must be taught "harder" than others? Do I *do* this?

☆ ☆ ☆

9. Do I teach a topic until the class *understands* instead of until it memorizes? Am I changing the form of my questions in every conceivable way to make sure they *do* understand?

☆ ☆ ☆

10. Do I frequently say to myself "Is this the most efficient way of doing this particular thing?" •

M.W.M.

Scholarship and Geology

(Continued from Page One Hundred and Thirteen)

In the field of invertebrate paleontology, the pioneer and voluminous works of James Hall (1811-1898) of the First New York Survey will probably never be matched in this country. Contemporaneous with Hall were Timothy A. Conrad (1803-1877), an early authority on Tertiary mollusks, F. V. Hayden (1829-1887) and F. B. Meek (1817-1876) of the Survey of Territories, Alpheus Hyatt (1823-1907) of the University of New Hampshire, and C. A. White (1826-1910) Robert W. Whitfield (1828-1910) and Amos H. Worthen (1813-1888) who worked with Hall on the Iowa Survey.

In the next chronological group appear W. M. Gabb (1839-1878) an early authority on foraminifera, H. A. Nicholson (1844-1899) on sponges, S. H. Scudder (1837-1911) on fossil insects, and H. S. Williams of Cornell on Devonian correlation. Then followed five brilliant workers in the persons of Charles D. Walcott (1850-1927) of the Smithsonian Institution, a great authority on the American Cambrian, and E. O. Ulrich of the U.S.G.S., pioneer in the detailed study of early Paleozoic stratigraphy and paleontology; John Mason Clarke (1857-1925) who succeeded Hall as an authority on the New York Devonian, together with Charles Schuchert and Charles E. Beecher (1878-1904) of Yale. Amadeus W. Grabau is an indefatigable worker who taught at Columbia and M. I. T. He is now dean of paleontogolists in China. Frank Springer (1848-1927), in conjunction with Charles Wachsmuth wrote, among others, three outstanding volumes on the extinct camerate crinoids which are standard in this field. The marvelous collection upon which this work is based is now on display in the U. S. National Museum.

To this era belong also August F. Foerste (1862-1936), G. H. Girty, a Yale graduate with the U.S.G.S., Angelo Heilprin (1853-1907), Robert Jackson, at Harvard, an authority on echinoderms, and Edward M. Kindle of Indiana and the Canadian Survey, James Perrin Smith of Stanford, noted for his researches on American Triassic ammonites, H. R. Pilsbry (Ph.D. Iowa) of the Academy of Natural Sciences, Philadelphia, an authority on recent and fossil mollusks, Rudolph Ruedemann of the New York Geological Survey, famous for his work on the extinct graptolites, and T. W. Stanton of the U. S. Geological Survey. The publications of Ray S. Bassler (Ph.D. George Washington) Head Curator of Geology at the National Museum on microfossils and his bibliographic volumes are well known. Another micro-paleontologist of note is Joseph A. Cushman (Ph.D. Harvard) of the Cushman Laboratory for the study of foraminifera. Percy E. Raymond, a product of Yale, has been specializing on the trilobites at Harvard and E. H. Sellards of Texas has given us much valuable data on fossil insects. For

his work on fossil corals and foraminifera, the name of T. Wayland Vaughan (Ph.D. Harvard) of the U.S.G.S. and Scripps Institution is justly famous. Other names deserving particular mention in invertebrate research are Carl O. Dunbar of Yale, J. B. Reeside (Ph.D. Hopkins) of the U. S. Geological Survey for his work on the Cretaceous cephalopods; C. E. Resser of the National Museum for his work on Cambrian faunas, Lloyd W. Stephenson (Ph.D. Hopkins) of the U.S.G.S., Raymond C. Moore of Kansas a worker on the upper Paleozoic paleontology, and the late Stuart Weller of Chicago.

The three greatest pioneers in this country in vertebrate paleontology are Edward Drinker Cope (1840-1897), Joseph Leidy (1823-1891) and Othniel C. Marsh (1831-1899). Upon Leidy, who labored indefatigably with the great Tertiary mammalian fauna that came in from the western surveys at the Academy of Science, Philadelphia, often rested the unpleasant duty of mediator between the other two whose ideas brought them into frequent conflict. Cope reflected his brilliant researches of Tertiary vertebrates from Philadelphia and seemed to be greatest along mammalian lines: Marsh, who seemed somewhat superior in his researches on fossil dinosaurs, taught and labored at Yale. It seems a pity that two such internationally noted experts in this field should have been so antagonistic toward each other, but it is possible that this same struggle may have been the incentive for work that raised them both to the heights. Aside from his greatness as a glaciologist, Louis Agassiz was a surprisingly fine ichthyologist as well. Other workers on fossil fish in this country were Edwin Claypole (1835-1901), Charles R. Eastman (1868-1918), John Strong Newberry of Columbia, and David Starr Jordan of Stanford. Along the lines of primitive Amphibia and reptiles, the names of Ermine H. Case, and Samuel W. Williston (1852-1918) of Chicago, and Roy L. Moodie (1880-1934) of the American Museum of Natural History stand forth. Henry F. Osborn of Columbia and the A.M.N.H. was one of our later all around geniuses in the field of vertebrate paleontology. He was a classmate of Wm. B. Scott at Princeton, who remained with his alma mater to carve out for it a niche in the Hall of Fame by his brilliant researches on Argentine Tertiary mammals. Two of the most outstanding authorities on dinosaurs at the present time are Charles W. Gilmore, Curator of Vertebrate Paleontology at the U.S.N.M., and Richard Swann Lull of Yale; while the greatest living authority on extinct sea reptiles in this country is probably John C. Merriam of the Carnegie Foundation at Washington. The study of fossil birds has been contributed to by O. C. Marsh of Yale, Frederick A. Lucas (1852-1929) of the A.M.N.H., and Alexander Wetmore of the National Museum. E. H. Barbour of Nebraska, O. P. Hay (1846-1930) of the Carnegie Institution, R. S. Lull of Yale and H. F. Osborn of the A.M.N.H., have done fine work on fossil elephants. Loomis of Amherst has done good work on fossil horses and, following in the footsteps of James W. Gidley, at the National Museum, we commend the work of C. Lewis Gazin. Wm. D. Matthew of the American Museum of Natural History was especially noted for his researches on the creodonts as was also Wortmann of Yale. Chester Stock of California Institute of Technology has published fine work on fossil edentates. The study of the primitive mammalian dentition of the Mesozoic mammals, started by Osborn at the A.M.N.H., has fallen into the able hands of George G. Simpson. As an authority on the Primates Wm. K. Gregory of this institution and Columbia ranks very high, and Remington Kellogg (Ph.D. California) is internationally known for his work on fossil whales. Lastly, as a professor of vertebrate paleontology first at Chicago and now at Harvard, the work of Alfred S. Romer is outstanding.

In the realm of economic geology we also find many fine workers in the United States. Under the heading of mineral resources, the Government-subsidized U. S. Geological Survey heads the list with such men as Alfred H. Brooks (1871-1924), an authority on Alaskan resources, while those of the United States proper have been amply covered by such men as Frank L. Hess, Gerald Loughlin, George R. Mansfield, Hugh D. Miser, Fred L. Ransome, Claude Siebenthal (1868-1930) and George W. Stose. Their work was a far cry from the sporadic pioneer efforts of such men as Charles T. Jackson (1803-1880) and C. U. Shepherd (1804-1886) of the early State surveys. In contrast, the work of C. H. Hitchcock (1836-1919) of the New Hampshire Survey and Henry Kümmel (Ph. D. Chi-

cago) of the New Jersey Survey has been extremely effective.

Among the teachers of note in this field are found Adolph Knopf (Ph.D. California) of Yale, C. F. Tolman of Stanford, and Heinrich Ries (Ph.D. Columbia) of Cornell. Along the lines of engineering geology the names of Charles P. Berkey of Columbia, C. W. Hayes (1859-1906) of the U.S.G.S., and T. L. Watson of Virginia (1871-1924) stand forth. In the study of coal and oil resources, one of the pioneers was Edward Orton (1829-1899) known for his classic work in Ohio. Associated with the United States Geological Survey in this field, one might mention the names of Charles Butts, Marius R. Campbell[5], Stephen R. Capps, and David T. Day (1859-1925). Ralph Arnold, a graduate of Stanford, and Frederick H. Lahee are consulting engineers of great repute in petroleum technology. The work of J. P. Lesley (1819-1903) and George Ashley upon the coals of Pennsylvania is also well known. Associated with universities at the present time, in this field, are Willard R. Jillson of Kentucky, E. R. Lilley of New York University, Wilbur A. Nelson of Virginia, and William T. Thom of Princeton.

Research upon the metallic ores ushers in a third and last list. Among some of the older workers on metallics are Wm. P. Blake (1826-1910), Samuel F. Emmons (1841-1911) C. R. Van Hise (1857-1918), and H. V. Winchell (1865-1923). H. Foster Bain, T. A. Richard, and Walter H. Weed were prolific writers as is also Josiah E. Spurr. Associated at the present time with the U.S.G.S. are Ernest F. Burchard (Ph.D. Northwestern), R. F. Hewett (Ph.D. Yale), Gerald L. Loughlin (Ph.D. Yale), and Arthur C. Spencer (Ph.D. Hopkins). Outstanding among university professors in this field are Edson S. Bastin of Chicago, Bertram S. Butler of Arizona, Louis C. Graton of Harvard, Wm. H. Emmons of Minnesota, Charles K. Leith of Wisconsin, and Joseph T. Singewald of Hopkins. Waldemar Lingren (1860-1939)a graduate of famous old Freiberg, occupied a chair at M.I.T. and was internationally known. Among the younger workers in this field, Thomas S. Lovering of Michigan and Donald H. McLaughlin of Harvard deserve particular mention. ●

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1. Hall published 4,539 quarto pages of printed matter and 1,081 full page plates. About the only person who exceeded this amount in quantity and scope was the Bohemian geologist Barrande.
2. The United States Geological Survey: U.S.G.S., Bul. 227; 205 pp., 1904.
3. Now living at 64 Broad Street, Clifton, New Jersey.
4. Special Lecturer at The Catholic University of America, 1900
5. Died December 7, 1940.

Homemade Equipment

(Continued from Page One Hundred and Ten)

While any size can be made, we have standardized on 2½" x 3½". These are filed for reserve after one photograph of each student has been mounted on a special card for his permanent record folder, which is kept in the office. Our school has a registration of about 900. To take from three to six negatives of each, enlarge each negative, and file, requires time and equipment. At least it makes worthwhile work for the Photo Club. The work does not always progress as well as one might wish, but it is well started. It is our tentative plan to complete the process once every other year, so the record folder of a child who has come up through the system will show his photograph at two-year intervals, from the first through the thirteenth grades.

Figure 6 shows a synchronizer for adjusting the electromagnetic flash gun on our 4" x 5" Speed Graphic. The cut is made to explain as well as possible both the construction and the operation. A wooden drum of slightly less than ten-inch circumference, covered by an 8" x 10" sheet of unexposed enlarging paper, rotates in a light-tight wooden box while the flash bulb is set off back of, and at the side of, the ground-glass focusing-back of the camera. Some light goes directly through the small hole in the shell to the paper, and some goes through the lens and shutter while open, through the large hole in the shell, and thence to the paper. Upon development, the relative position of the dark spot caused by the light which went through the lens and the dark spot caused by the light which went

directly through the small hole on the right, shows the time relation of the flash to the operation of the shutter. If the spots indicate a slow shutter the adjustments are made to the electromagnet and another test is made. This procedure is repeated until proper synchronization is accomplished. We now have in an incompleted stage an Edgerton flash, the principle of which is to build up an electrical charge by a 110-volt rectifier on a 50 mfd. condenser and then discharge across a gaseous tube. The duration of the flash is very short, making good stop-action pictures.

As far as we can see, time is the only limit in this type of work. We do think that high school teachers of science should have their own training emphasis shifted somewhat away from the theoretical, as at present, and somewhat toward the practical. That is, to work with and to construct homemade apparatus, one needs to use lathes, grinders, saws, etc. It is difficult to get away from the fact that the test of science is to be able to use it.

In this article we have used some of our projects to illustrate what can be done. Many other teachers of science who believe this type of work is well worth the time and effort it requires are carrying on successful programs. ●

Ant Lions

To nature lovers the ant lion, of the order *Myrmeleonidae*, is a most interesting insect. So many names have been given to him that the wonder is that he has not found his way into Mother Goose especially since so many know him by the euphonious name of "Doodle Bug.'

Last October, while inspecting an interesting geological formation, I found the dry floor under the overhanging rock thickly spotted with the telltale craters of that predacious creature.

Gathering up a handful or two of the dry sandy loam containing several specimens, I placed the contents in a pint collecting jar and carried them to my laboratory bench. There I proceeded to forget them completely until one bright May morning of the following year. Well! Well! When I looked into the collecting jar there was my ant lion patiently awaiting the victim which never could appear.

I had often wondered how long an ant lion might survive without food and here I had found that seven or eight months had elapsed and apparently there was still vitality in the insect—so patiently awaiting at the bottom of his tiny crater. Or was he?

I was soon to find out. A lively ant dropped into the open crater brought a quick and most convincing response. Here again Lady Fortune was offering me an opportunity I had long sought. After such a long fast, what would happen if I proceeded to feed him regularly? I was soon enlightened.

The large black ant which I dropped into the den daily for about two weeks furnished the necessary nour-

ishment to continue the life cycle. One morning at the end of the two-week period I failed to note the tell-tale crater indicating liveliness of my specimen, nor the next day, nor the next.

Pouring out the contents of the jar upon a white paper I found the familiar mouse-colored spherical cocoon about the size of a small marble. This was followed late in July with a beautiful free flying stage.

Thus, through carelessness, I had been able to follow through almost a complete metamorphosis. Even neglect has its compensations.

David M. Rial, Principal,
Brashear Public School, Pittsburgh.

Quality Milk

(Continued from Page One Hundred and Fifteen)

and spread or smeared over a surface of one square centimeter. When it has been allowed to dry under sterile conditions it forms a film. The fat is dissolved, and the film fixed by a fixing solution. The smear is then stained with methylene blue and examined under an oil-immersion lens.

There are other measures of quality applied to milk, with which I do not deal regularly. One of these is the so-called methylene blue reduction method. This involves the change of color of a reducible dye, resulting from the consumption of dissolved oxygen by growing bacteria. This is a rapid test, but due to its inaccuracy it is not used to any great extent. There are tests for various types of bacteria which are less common to milk. There is the phosphatase test for proper pasteurization and other tests as well, but I shall not consider them in this paper. I have attempted to consider only the ordinary work of the laboratory.

Although my work is a bit on the routine side, I enjoy it because constant changes and improvements are being made and if we may judge by the past, will continue to be made in the future. ●

Contributions

(Continued from Page One Hundred and Nine)

Elementary School

What classroom conditions are necessary for education for democracy through science in the elementary school? Among the many conditions that are desirable, I shall list but four as of first importance:

(1) The teacher in the room is ambitious, enthusiastic, and alert. She need not be a trained science teacher but she must know children.

(2) The pupils are supplied with modern science books written at the proper grade level.

(3) The actual material of the natural environment to be studied is in the classroom and in

the pupils' hands for examination; such as a leaf, a magnet, a mass of frogs' eggs, a rock, a piece of coal, or a pan of water.

(4) The teacher is scientific in attitude and uses the scientific method of approach adapted to the grade at which she is teaching. By this approach, the class recognizes a problem and solves it by experimenting, looking for facts and asking and answering questions.

The alert teacher is one who senses the needs and interests of her pupils and accepts their problems for investigation; or she leads them to recognize as their own a problem of her own choosing, such as: Is a tree dead in winter? Does fire need air? Does a toad give warts? Is electricity dangerous?

Science books are not used as readers, but as sources of information. They should be accurate as to fact, interesting, and readable.

The materials of instruction are not expensive apparatus. Much of it is furnished by pupils, especially older boys and girls acting in the capacity of a laboratory squad. The "5 and 10" store, out-of-doors, the home, and the junk pile are sources rich in science materials.

The method of conducting the recitation is quite democratic because pupils are thinking for themselves and working together. For example, in the months of March, April, and May one of our topics is *Frogs and Toads.* Children hear and are curious about those harbingers of spring—the peepers. The first step in teaching this topic is the approach. It may be in the form of a trip, a poem, a song, a picture, or some observation by a pupil in the class, such as "I heard noises last night which mother said were the peepers. What are the peepers? How big are they? Where do they live?" A problem is stated, for example: "How do frogs and toads live?" The animals and their eggs are then brought into the classroom for observation. Questions are asked and answered. Science books are read. Some correlating activities engaged in are oral English, composition work, spelling, vocabulary building and drawing. Everything becomes vital because it is used in a practical situation. The lesson closes with a conclusion which answers the problem How do frogs and toads live? In the primary grades, the conclusion may take different forms, such as a play.

The outcomes of science teaching, including grades 1-6, as stated in the *31st Year Book, A Program for Teaching Science,* are well-known to all. They are, knowledge of the facts and principles and generalizations of science; the scientific method of thinking; and the acquisition of the scientific attitudes. It is the acceptance of these outcomes, as goals, that have introduced five major problems in our elementary science program. Time permits me only to state and to give you such solutions as we have found to be practicable. The problems are as follows:

1. Scope and sequence of that which is offered for learning.

2. In-service training for teachers.
3. Passing on of misinformation.
4. Flexibility of program to meet needs and interests of pupils without useless repetition of content in succeeding grades.
5. Creating classroom situations in which pupils are made to think.

For scope and sequence we use the State Syllabus, modified to correlate with our social studies program. For in-service training we use lectures, motion pictures, and science discussion groups. To keep misinformation at a minimum we are trying the experiment of asking Junior High teachers to pass such misinformation back to the teachers of the intermediate grades. As yet we have found no way whereby we can provide for the flexibility of program asked for by the classroom teacher and at the same time avoid some useless repetition of science content.

Can pupils be trained to think? In a recent science discussion group consisting of fourth, fifth and sixth grade teachers, representing about 30 schools, this question arose: What evidence have we that our pupils are being trained in thinking through science? We defined thinking as putting to work in a new situation old ideas already in the mind. At the end of this paper we are presenting some of the evidence submitted by the group.

In a democracy the people rule. Their ability to do so effectively is measured in terms of the steady growth of the individual and his willingness to work with the other fellow for the common good. It follows then that in the schools of a democracy the children of the people should be trained to look for facts, to use them in critical thinking and to have a scientific attitude. We believe a twelve-year science program can be so administered as to give specific training in fact finding, thinking and judging. Let us accept this program as a goal so that it may be a vital factor in the American Way of Life during 1941 and 1942 and the years that follow. ●

DO WE TEACH PUPILS TO THINK?

Six classroom teachers answer:

NO. "The class had learned that during the Coal Age the earth had a warm humid climate. About the same time the Spitzbergen Islands, and their huge coal deposits, were mentioned in geography. Yet no one in the class could put his knowledge of the Coal Age to work and conclude that at some time in the past the Spitzbergens must have had a warm humid climate.

" I think most of the ideas learned in science are kept on a little shelf reserved for science only."

●

YES. "A sixth grade class was told that in making his first electric light bulbs Edison removed the air from the bulb. When asked why, one pupil said that if it had not been done the thread would have burned up and the light would have gone out. The pupil explained that when the class had studied fire it was learned that fire needed air in order to burn. This pupil applied a fact learned at another time, which is thinking."

YES. "A fourth grade class was told that warm air is lighter and rises. A nine year old boy asked 'Then why does an aviator put on heavy clothes when he goes up in a plane?'"

●

YES. "The 'problem child' of the class came to me with an illustrated travel folder of Italy and these questions: How come there is snow on the mountains? I thought Italy was warm. Snow falls on the ground and piles up higher and higher, doesn't it? How did it get way up on the mountain tops when there is none on the ground?"

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YES. "A book said it took George Washington six weeks to reach his destination on a scouting trip but that he made the return trip in four weeks. There were many 'maybes' suggested. He may have had to dodge Indians. He had to clear the way on the outward trip. He found an easier way to return. He needed time to study the land on the way out. He learned short cuts on the way out."

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YES. "On Monday morning following the Sunday on which the clocks were set ahead a fourth grade pupil asked: Did the sun change its time? Did the pupil here sense a cause and effect relationship?" ●

☆ ☆ ☆

The Kewaunee Manufacturing Company, Adrian, Michigan, has recently issued an attractive new catalog of Kewaunee automatic-adjustable stools and chairs. Are you refitting your laboratory?

Dividends From a Club

(Continued from Page One Hundred and Three)

are manufactured and used have been prepared for classroom exhibition. Some members have contributed to the material used on bulletin boards.

Another example of applied club work is to draw the membership of the laboratory helpers' squad from the membership of the club. These pupils help the laboratory assistants to clean, store, distribute and gather apparatus as needed. This application was developed by the present sponsor who is a laboratory assistant.

The club activities already mentioned present the difficult problems of danger, the need for apparatus and material, and sufficient time. These drawbacks are inherent in the nature of the work done. They must be met before club work of the type indicated can hope to succeed.

Few pupils have had laboratory experience sufficient to make them safe workers unless they are constantly checked by the sponsor. Close supervision is absolutely necessary to prevent accidents. More safety instruction must be given than that taught in the average classroom.

The amount of materials and apparatus required is large. The financial resources of a club will not be sufficient to meet the bills if supplies are purchased. Most of the supplies needed must be furnished by the school stockroom. Unless the man in charge of the stockroom is sympathetic, the work of the club may be hampered considerably.

Sufficient sponsor time is the most difficult problem. It is the most important item in the successful operation of a club dedicated to an extensive program of activities. Pupils will wish to work each day during free periods, lunch periods, and after regular school hours. Obviously, one sponsor cannot be expected to be available throughout the day. This situation can be remedied by making both a teacher and a laboratory assistant club sponsors. The laboratory assistant does not have as rigid a schedule as a teacher. Also, part of his hours usually come after school has closed for the day. He can help in the matter of procuring supplies. The teacher will usually conduct formal meetings while the laboratory assistant may supervise the work of individual members engaged in project work. In this way a sponsor will always be available during the day.

There is a tendency for some pupils to spend too much time in club work. It may be necessary for the sponsors to limit the amount of time that a pupil is permitted to spend in club work because of the danger of very enthusiastic members lowering their subject average due to excess club work rather than study.

The sponsoring of science clubs should be rotated among the teachers in order that each teacher may have an opportunity to enjoy this refreshing experience. ●

Emotional Blocks

(Continued from Page One Hundred)

The student who fears to give himself to the study of chemistry because he feels that he will lose his religion sometimes arrives at this conclusion in this way. Chemistry is a science. Science and religion are opposed. Hence, if I become absorbed in the study of chemistry I will lose my religion.

What can be done here is largely a matter of special circumstances. Certainly, one thus interested in religion must know someone, generally the teacher of religion, the minister, or the priest, in whom he has confidence. An appeal for help from this counselor should result in cooperation which would dispel in the mind of the student the concepts on which his harmful conclusion is based.

Such conferences often result in a summary akin to this. Religion is the relationship of myself to the Creator. Why did the Creator create a physical universe? If it was to share, to externize Himself, to make known a limited bit of Himself, a special kind of creature was needed, combining a physical body to contact the physical universe and an intelligence to interpret it. Why did He create man? Man, as far as we know, is the only being incorporating the requirements of a physical body and an interpretating intelligence. It appears then that man was created to study the physical universe and to interpret it. That is his relation to the Creator. A segment of this work is chemistry.

Great thinkers of all ages have urged men not to worry about their temporal needs but to devote themselves to the purpose for which they were designed. A promise is attached to this recommendation, the promise that our material wants will then be supplied. This dictum is not only true because great thinkers have enunciated it; they enunciated it because it is true. The fulfillment of the promise attached to the admonition certainly is reasonable on the assumption that it is our purpose to study our environment and to interpret it. This activity results in a knowledge of the environment which enables us to adapt ourselves to the environment or to adjust the environment to our needs.

The success attendant upon the very small scale on which the idea has been tried so far certainly bears out the hope that material scarcity can be eradicated by this programme. The one chosen to minister to the spiritual wants of the student is in charge of this area of thought, and the layman reverently avoids intrusion. Certainly a plea for help and a request that thought be given these matters by spiritual counselors will meet with courteous and careful attention. Much encouragement has been given this suggestion by some members of the clergy in several schools of religious thought. ●

☆ ☆ ☆

Do not allow bottles of carbonated beverages to freeze. If thawed too rapidly there will be an explosion. Never thaw by holding the bottle under a hot water tap.

The World of Color

(Continued from Page One Hundred and Two)

inverted position. Similar reversed images are formed by the lens of a photographic camera. This fact immediately brings the question, why then do not all objects appear to us also in an inverted position? The answer is, that we have to educate our own eyes as to the actual position of the object.

The fact that the eye alone has no means of judging the proper position of objects by themselves may be very simply proved by looking at some familiar object through a telescope. The observer will be entirely at a loss to state definitely whether the image is upright or inverted. If we were to fit ourselves with a pair of lenses that would make all objects appear inverted, we would certainly experience, at first, some difficulty in performing even the simplest tasks. By and by, however, our eyes would become accustomed to this sudden change and the objects would again take their normal position. If the inverting lenses were taken off now, once more we would see all objects inverted.

Thus, it is important to realize that although we do see *through our eyes*, our picture of the outside world is really formed *by our mind*, which in the early stages of seeing must cooperate with our more reliable sense of touch. ●

Good News!

(Continued from Page Ninety-seven)

modations should be made well in advance of the Conference to the Chairman of the Hospitality Committee, Sister M. de Chantal, O.S.U., Ursuline Academy, Winebiddle Avenue, Pittsburgh, Pa.

SPECIAL NOTES

There are no special invitations.
All who are interested will be welcome.
Accommodations will be provided for visiting Sisters.
Sisters will be met at trains.
There are no fees of any kind.
There will be no exhibit of student project material.

★

Free Booklet

The United States Rubber Company, Rockefeller Center, New York City offers to schools for classroom use a 46-page booklet, *The Romance of Rubber*, which deals with the history, manufacture, and uses of rubber. It is attractively illustrated. A copy will be sent free to any teacher who requests it.

★

Dr. William J. Bonisteel of the Department of Botany of Fordham University is Editor of *Torryea*, the famous journal of botanical notes and news published by the Torrey Botanical Club of New York City.

Bible Plants

(Continued from Page One Hundred and Six)

oil is extracted in India from the fruits of *Balanites aegyptiaca* Delile, (Zygophyllaceae), (Fig. 6), and it is believed that this plant was the source of the "balm" of scriptures.

Frankincense is made from the gummy exudate of *Boswellia thurifera* Roxb. (Burseraceae).

Myrrh is an oriental perfume and medicine. It is made from the exudate of stems of *Commiphora (Balsamodendron) Kataf* (Forsk.) Engl., (Fig. 4), (Simarubiaceae) and of *C. myrrha* (Nees) Engl.

Spices as known to the Jews were perhaps derived from many plants, among which were probably the very spiny *Astragalus gummifer* Labill., and *A. tragacantha* L.

Corn and *Wheat* of the Bible are both *Triticum aestivum* L., or other cereals equally well known to us, but never *Zea Mays*, our own American "corn." ●

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★

The Aurora Borealis

The occurrence of the unusually brilliant display of the aurora borealis observed on September 18, 1941, was predicted two days in advance by H. W. Wells of the Carnegie Institute in Washington. He had noted an unusually large and growing group of sunspots about to pass over the center of the sun. The aurora is formed when particles from exploding sunspots strike oxygen and nitrogen molecules in the upper atmosphere, wrenching off some of the outer electrons of the atoms and causing them to luminesce. The prediction could be made two days in advance because it takes about 48 hours for the particles from the sun to reach the earth, although they travel at enormous speeds.

★

Just as heavy hydrogen has been used as a tracer atom in biochemical reactions, heavy oxygen is now being employed to determine the reactivity of oxygen atoms in sugars.

Clouds of Iron

Discovery of iron in the dust and gas clouds of interstellar space has just been announced by astronomers of the Mount Wilson Observatory.

This follows shortly an announcement from the University of Alberta that these clouds also contain ionized molecules of carbon-hydrogen and carbon-nitrogen.

Existence of the space clouds—extremely thin but of enormous size— in the depths of space between the stars had long been known to astronomers because of the slight reddening of starlight which passes through them.

Identification of the elements of which they are composed is possible because of the fact that under certain conditions atoms of an element will absorb from light which falls upon them those wave-lengths which they themselves would emit if they were rendered luminous. This results in dark lines in the spectra of stars where these wave lengths ordinarily would be represented.

Up to the present there have been identified lines of calcium, sodium, potassium and titanium among the elements, and gasses composed of simple combinations of carbon and hydrogen and carbon and nitrogen. Several absorption lines have remained unidentified.

★

For A Safer America

Single copies of a leaflet explaining how schools can meet the challenge of President Roosevelt for every citizen to unite in an all-out campaign against accidents may be obtained gratis by writing Safety Education Projects, Research Division, National Education Association, 1201 Sixteenth Street, N. W., Washington, D. C.

★

Care should be used in handling colchicine, the magic drug that speeds evolutionary processes in plants. In the right concentration a small amount may cause skin irritation, or even blindness if it gets into the eye.

★

A Christmas Present

Why not present a subscription to *The Science Counselor* to one of your science teacher friends as a Christmas gift? It costs only one dollar.

The Science Counselor makes a good Christmas gift.

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